THE COMMISSION ON THE COSTS
OF TRANSPORTING GRAIN BY RAIL

TECHNICAL APPENDIX
REPORT VOLUME I

NON-CAPITAL COSTING ISSUES

THE COMMISSION ON THE COSTS
OF TRANSPORTING GRAIN BY RAIL

TECHNICAL APPENDIX
REPORT VOLUME I

NON-CAPITAL COSTING ISSUES

JULY 1979

Available in Canada through

Authorized Bookstore Agents
and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Hull, Quebec, Canada K1A 0S9

Catalogue No. CP32-24/1980-1-2E Canada: $6:00
ISBN 0-660-10687-6 Other Countries: $7.20

Price subject to change without notice

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

Schedules

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

PREFACE

This volume of the Technical Appendix describes in greater detail the other than capital cost material which was analyzed by the Commission in arriving at the conclusions contained in its Volume I Report.

Just as some issues required further clarification in this Technical Appendix, some issues were not oriented towards technical analysis, were resolved or agreed to by all parties and/or were sufficiently elaborated upon in Volume I. Those issues which arose during the Commission's inquiry which will not be discussed further in this Technical Appendix are listed below.

- Canadian National Car Cycle - at issue was the definition employed by CN. This issue is adequately discussed in Report Volume I at pages 181-183.

- Changed procedures since the MacPherson Commission - This issue is discussed to the extent necessary at pages 56-57 of Report Volume I.

- Commodity - initially, it was contended by some groups that export grain could not be adequately costed, exclusive of other grain movements; the submissions prepared by the Provinces and the railways disproved this assertion.

- Difference in CN Accounting Procedures and Costing Manuals - reconciling the two proved sufficiently complex that it was not accomplished by the Commission. A recommendation was made by the Commission that the CTC order CN to produce their costing manuals in the same format as their accounts are kept.

- Economic Costs - the Commission determined that economic costs and not cash expenditures would be the basis of the study. This was reflected in the Cost Studies prepared by the Railways and Provinces.

- Federal Government Costs - all parties agreed that the Federal Government incurs costs related to the transportation of statutory grain by rail and that such costs should not be attributed to the railways.

- Freight Car Costs - no attempt was made by the Commission to study railway claims that older cars require more maintenance. Even the railways could not substantiate this claim due to a lack of data. The Commission agreed that the different assignment of repair costs between time and mileage by the two railways did not appear correct. This did not lead to additional analysis due to the lack of adequate

data and the fact that the costs were not significantly affected. The Commission recommended that the CTC order a consistent approach between the two railways.

- Institutional Costs - institutional Yard and Road Crew costs were adequately discussed in Report Volume I at pages 152-162. Additional clarification on the circuity issue is included in Report Volume II which analyzes the cost implications of the Hall Commission recommendations.

- Locomotive and Freight Car Costs - a recommendation was made that an analysis of the variability of these costs be undertaken by the CTC for final resolution.

- Milling-in-Transit - the method of costing these movements was agreed upon by all parties during the Technical Committee meetings, was fully explained in Volume I and was detailed in the Commission's Statement of Issues and Procedures.

- N.A.R. Costs - the fact that this Class II railway does not produce sufficient cost data to specifically cost export grain movements led to the use of the same methodology as was used for MIT traffic. This is explained at pages 171-177 of Report Volume I.

- On Going System - all parties agreed the objective of the Commission was to cost an ongoing system; not one which was to be liquidated.

- Port Mann - Victoria Ferry Costs - The Commission excluded the cost of this service which is required to ship grain to Victoria. This conceptual decision did not require technical analysis and is explained at page 188 of Report Volume I.

- Stations - the Commission made a decision based on concept rather than technical information. This is fully explained in Report Volume I at pages 119-121.

- Study Year - following extensive discussion in the Technical Committee and at the Public Hearings, all parties agreed that 1974 represented contemporary conditions.

- Traffic, Operating and Revenue Characteristics - At page 15 of Report Volume I, the Commission stated that: "Further details of the traffic, operating and revenue characteristics are included in the Technical Appendix." Upon reflection, we find that the further detail and information presented in Report Volume II and the fact that no significant controversy regarding these items was raised during the Inquiry suggests no need for additional discussion.

The first four chapters of this Technical Appendix are related to variable cost issues. The first chapter reviews the basic practices and techniques used to develop the costs of transporting statutory grain by rail, the differences in the costing approaches utilized by CN and CP, and the current status of the additional research recommended by the CTC in Reasons for Order No. R-6313 Concerning Costs Regulations.

The second chapter presents the details underlying the Commission's analysis of the issues raised by the parties which were related to the use of regression analysis in the cost finding process. The third chapter discusses the Commission's findings on the issues associated with the normalization of costs while the fourth chapter is concerned with the remaining variable cost issues. The fifth and final chapter details the Commission's findings on all constant cost issues raised during the Inquiry.

CHAPTER I

COSTING PRACTICES

In the process of developing the costs of transporting grain by rail before this Commission, both the railways and the provinces employed several costing techniques. Each of these is designed to attribute the incurred expenses of the railway enterprise to the services actually produced or the workloads* actually expended in the production of that service.

In simple terms, this may be illustrated by the movement of a way freight train up and back on a grain gathering line. In this activity, the railway distributes empty railway cars to the elevator locations and collects loaded cars of grain for furtherance to export. In providing these services, the railway generates several output units or workloads including:

- gross ton-miles
- train-miles
- car-miles
- car-days

---

*In this chapter, the terms output unit, workload and service unit will be used interchangeably to refer to the physical dimensions or characteristics of the services actually performed by railway transportation.

- train switching miles or minutes
- locomotive unit miles.

IDENTIFICATION OF COSTING TECHNIQUES

The costing techniques utilized can be described generally as:

- direct analysis
- direct assignment
- indirect assignment or factoring*
- regression analysis (simple or multiple)

These techniques are designed to associate the variable portion of expenses recorded in the accounts of the railways with the workloads generated in the provision of a particular service or group of services.**

Direct Analysis

Direct analysis (denoted "allocation" by the Provinces),*** assigns expenses in direct proportion to the related workloads or output units generated. For example, Maintenance of Diesel

---

*See Exhibit AMS-1, p. 46 where this term is introduced.

**The variable portion is approximately 80 percent of system total costs.

***Exhibit AMS-1, p. 46.

Locomotives (UCA a/c 314)* is related to diesel unit miles for each class of diesel locomotives. This is accomplished by dividing the total a/c 314 maintenance expense incurred by the total unit miles travelled by the diesel units in each class to generate a unit cost per diesel unit mile by locomotive class. This procedure allocates all of the dollars in the account and implicitly assumes that the expense under analysis is 100 percent variable (i.e., no fixed costs exist) with the associated output units. Slightly more than 40 percent of total railway costs are developed in this manner.

Direct Assignment

In the railway system of costing, a small number of accounts (less than five percent of system total costs)** are assigned directly. This is a form of specific costing which assigns the total dollars under analysis to a particular service, type of equipment or traffic. The dollars so assigned are taken as a single item or allocated to output on a simple ratio basis, using basic measures such as revenue dollars, net

---

*UCA refers to Uniform Classification of Accounts. Uniform Classification of Accounts for Class I Common Carriers by Railway, Board of Transport Commissioners for Canada, 1959.

**In the costing of the grain traffic by this Commission, all of the maintenance, depreciation and capital costs associated with the roadway of the grain dependent branch lines have been treated as an identifiable 'variable' cost which has been assigned, directly, to the traffic. Therefore, for purposes of this study, direct assignment constitutes substantially more than five percent of the total grain costs.

ton-miles or car miles. An example of expenses assigned in this fashion is the cleaning of grain cars (UCA a/c 402). Here the recorded expenses are clearly related to the movement of grain to export positions. Such expenses were specifically identified by the railways and included along with the variable costs identified by the other costing procedures. The underlying assumption of variability in this procedure is that the identified total dollars will vary with quantum changes in service or output units; the result is an implicit assumption of 100 percent variability.

Indirect Assignment

The third process of developing variable costs has variously been termed indirect assignment, factoring, and/or overhead prorationing. The process is used in situations where it cannot be demonstrated that the expenses clearly vary in some proportion with changes in specific workloads, but where it can be demonstrated that the expenses do vary with changing levels of other railway expenditures which, in turn, vary with identifiable changes in workloads or service units. For example, the maintenance of shops and enginehouses used to repair diesel locomotives, cars, and other equipment, varies with the total dollars expended in maintaining each of these equipment types. These direct maintenance expenditures, in turn, vary with identified workloads, e.g.:

Shop and enginehouse maintenance → is dependent on → Diesel locomotive maintenance
Freight car maintenance
Passenger car maintenance
Vessel maintenance
Work equipment maintenance
Other equipment maintenance

diesel locomotive maintenance → is dependent on → diesel unit miles

In this manner, indirect costs are associated with output units for costing purposes. This assignment process may utilize regression analysis and/or direct analysis in linking the dollars to the output units. The expenses developed in this manner may be seen to have any level of variability* with output units. Approximately 10 percent of system total costs are allocated in this fashion by the railways.

Regression Analysis

Regression analysis is a statistical technique employed in railway costing to allocate one or more expenses to one (simple regression) or more (multiple regression)

*If the indirect costs are 100 percent variable with the direct costs, and the direct costs are 100 percent variable with the output units, then the indirect costs will be 100 percent variable with the specified output units. To the extent the variability of either expense category is less than 100 percent, the resulting indirect cost/output unit variability will be reduced.

output units. In railway costing, the development of such a relationship assumes that there is some causative role played by the output units in explaining variations in the levels of railway expenditures in the accounts under examination. Implicit, also, in this approach is the assumption that the costs do not vary in the same proportions as do changes in the associated output levels. This gives rise to costs which are fixed (or constant) over observable ranges of output variation. An example of an expense analyzed by regression analysis is yardmasters and clerks (UCA a/c 377) wages which are "regressed on" yard switching miles to produce a cost per yard switching mile. Approximately 25 percent of railway system total costs are developed through simple and multiple regression techniques.

DIFFERENCES IN THE RAILWAYS' COSTING APPROACHES

Throughout Volume I reference is made to costing differences contained in the submissions of the parties to this Inquiry. The railway companies themselves differed somewhat in the methodology each employed in their submission to the Commission. Some of these differences stem from the fact that the two companies maintain different accounting and internal management information systems. These systems, in turn, dictate what information can or cannot be developed. Other differences in their approaches occurred strictly on the basis of

methodological differences and still others as a result of different conceptual positions.

Some basic differences between the two companies resulted from the manner in which they prepared their output units and in the extent to which their respective accounting systems are disaggregated. Less significant differences are found in the way that the two companies compute communications, general, freight car repair, fuel, road property investment and traffic expenses.

The following discussion of the differences contained in the submissions of the two companies is very brief, but it will serve to highlight some of the more interesting and significant issues which were discussed by the parties during the course of the Commission's inquiry. Many of these differences are discussed in greater detail in subsequent chapters of this Technical Appendix.

Accounting Systems

CP Rail keeps its accounts for its own internal purposes in the manner prescribed in the Uniform Classification of Accounts. Canadian National, on the other hand, has broken its internal accounting into many more detailed sub-accounts. Both Canadian National and CP Rail prepare their annual reports to the CTC in the format prescribed by the Uniform Classification of Accounts.

As was indicated in the discussion of this issue in Volume I, the fact that the CN accounts are more detailed than are CP Rail's does not necessarily mean that CN's accounting system is better. Theoretically, the more disaggregated CN system of recording data allows increased opportunity for management control and more specificity in the costing system; and, the more aggregated accounting method of CP Rail provides less opportunity for specificity in costing. However, the quantity of source numbers under an elaborate accounting system often results in less accurate or inconsistent reporting.

> When you produce a very elaborate accounting system you are forced into very detailed reporting and information systems at the lowest level of management supervision. I think that introduces some refinement at a level where they are less subject to, shall I say, higher accounting authority than in a system where you have a less elaborate series of breakdowns.*

Mr. Saunders adequately summed up the comparison between the two systems:

> So you cannot really say that one produces a more or less accurate answer or more or less reliable answer or more or less precise answer until you have carried it from the account down to the end product of unit cost for given traffic. **

---

*Transcript, Vol. II, p. 195.

**Ibid., p. 191.

The adequacy of both the Uniform Classification of Accounts and Canadian National's internal system were discussed at the hearings. We have recommended to the Canadian Transport Commission that they inquire into the adequacy of the Uniform Classification of Accounts as a basis for development of costs for regulatory purposes, for as Mr. Saunders explained:

> I am not comfortable with either system... *

Communications Expenses

The two railways used different variability levels for communications expense. CP Rail computed their unit costs on the basis of a 100 percent variability factor whereas CN used a 70 percent variability factor. As discussed *infra*, the Commission accepted the CP Rail position and recalculated CN's unit costs to reflect a 100 percent variability factor.

General Expenses

Canadian National Railways used regression analysis to compute general expenses and found these expenses to be over 100 percent variable. CP Rail used direct analysis on the strength of a special study of U.S. railroads which showed

---

*Ibid., p. 194.

these expenses to be 100 percent variable. While the methods for obtaining their respective results differ, the end results are consistent and we have used the costs submitted by both railways for this account.

Road Property Investment

Canadian National maintains primary road property accounts on a system basis only and cannot obtain accurate cross-sectional data. CP Rail maintains primary road property accounts for some 430 property sections. As a result, CN, in its submission to this Commission (consistent with Order No. R-6313) used CP Rail's road property investment functions to determine the investment costs applicable to their movement of statutory grain. CP Rail, of course, utilized their own investment functions.

Canadian National are preparing an analysis of a 31 subdivision sample in an attempt to develop their own roadway investment function. The Commission urges Canadian National and the Canadian Transport Commission to treat this as a priority item to be resolved as quickly as possible.

Fuel

For its initial submission to the Commission, Canadian National used an engineering formula developed by W.J. Davis

some years ago to estimate fuel consumption. Canadian National, however, found that the "Davis Formula" understated actual fuel expenditures. Subsequently, in its rebuttal submission Canadian National increased the fuel consumption rate from 1.23 gallons to 1.515 gallons per MGTM. The new consumption rate was based on a study analyzing 11 years of total system fuel statistics and represents an overall average for fuel consumption for freight services.

CP Rail estimated its fuel costs for this Commission by utilizing train engineer estimates made following each train run. This method and the relative accuracy is discussed in more detail on page 150 of Volume I.

We have accepted the estimates of both railways for use by the Commission in calculating the costs of transporting grain by rail.

Freight Car Repair Expenses

CP Rail assigned 25 percent of its freight car repair costs to time and 75 percent to mileage. This is consistent with the procedures outlined in their costing manual on page 8.030.1 and is based on studies undertaken by the Interstate Commerce Commission in the United States. Canadian National assigns approximately 50 percent of these costs to time and 50 percent to mileage. The total costs were not significantly

influenced by the method used in calculating freight repair costs and the Commission has therefore accepted both companies' estimates. However, we have done this with some feeling of uneasiness as stated on page 131 of Volume I:

> ...we found it difficult to accept that the causes of car repair costs on the two railways justify the significant difference in assignment to time and mileage.

Traffic Expenses

CP Rail undertook a special study of traffic expenses specifically related to the carriage of grain. CN undertook no such study and consequently did not include any traffic expenses in its submission. This Commission accepted the CP Rail submission on Traffic Expenses but did not include any for CN since no information was available to support such an allocation.

Main and Branch Lines

For the rebuttal hearings, Canadian National:

> ...reviewed its analysis of roadway maintenance expenses in the light of discussion held at the Hearing. It was decided to produce a new regression equation for roadway maintenance based on observations which exclude, as far as possible, branch lines with abnormal maintenance levels. *

---

*Exhibit CN-14, p. 51.

Canadian Pacific did not identify or distinguish between main and branch lines for final computation of its maintenance of roadway costs for submission to the Commission.

Allocation of Constant Costs

On this issue, CN and CP did not differ in advocating the fact that grain traffic should bear some portion of constant costs, nor did the two railway companies differ from each other in their methodology. However both companies changed the methodologies employed in their initial submissions during rebuttal. This change resulted in CP's claimed allocation for constant cost decreasing from the $20.8 million shown in their initial submission to the $15.8 million shown in their rebuttal submission. Canadian National, using the same methodology as CP, had an increase in their allocated constant cost from $25.6 million to $32.5 million.

Negative Constants

Canadian National used unadjusted variable unit costs derived from regressions which had negative constants whereas CP Rail adjusted such unit costs in the fashion prescribed by the C.T.C.

> The Commissioner: All right, sir. Have the regression equations or the unit costs developed from regression equations used in this presentation been adjusted to reflect the zero "a" factor when the

equation itself produced a negative "a" factor as the CTC does in the approval of unit costs?

Mr. Saunders: Yes and no. Yes, they have been adjusted in the CP presentation and no, they have not been adjusted in the CN's presentation.*

...

The Commissioner: Mr. Pringle, can I also take your position to be that in your judgment the CTC adjustment does significantly distort unit cost factors and furthermore is not a valid adjustment?

Mr. Pringle: That is correct.**

...

The Commissioner: Yes. You (CP) have accepted it in preparing your unit costs for this submission because the difference is not worth hassling about; is that the position?

Mr. Romoff: That is a fair statement. As a principle I have no problem with the result that the constant costs can be negative. ...If the dollars involved are small, if the accounts involved are not all that important, at some point one has to make a judgment as to what is worth fighting about and arguing about, both before the CTC and before this body. We have made such a judgment. ***

COST ORDER NO. R-6313 RECOMMENDATIONS AND CURRENT STATUS

In the Volume I Report, the Commission indicated its concern about the lack of general knowledge on the part of interested parties of changes over time which have occurred in rail

---

*Transcript, Vol. 2, 241.

**Ibid, p. 243.

***Transcript, Vol. 6, p. 1000.

costing methodologies or concepts. The Commission believes that the apparent secrecy, intended or not, which restricts this information from all except the Canadian Transport Commission and the railway companies, is partly the cause of the lack of progress in resolving and finally putting to rest some of the controversies which have existed in railway costing methodology for many years. On pages 192 and 193 of Volume I, the Commission described some suggested procedures and commented:

> ...we believe implementation of these procedures will permit the non-railway parties to be informed of the current status of costing research, will eliminate some of the non-railway parties' concerns and doubts about the reliability of cost study results conducted under CTC approved concepts and methodologies, and will enable the CTC, the railways, and others to focus their attention on those issues which are truly unresolved.

Throughout the course of this Inquiry The Commission received valuable input and insight into the methodology to be used to determine the cost of transporting grain by rail from many parties including the railway companies, the Provinces of Alberta, Manitoba and Saskatchewan, the grain handling companies, producer organizations and many expert witnesses representing these parties. To provide this input, a great amount of time, effort and money was spent by the parties in examining, analysing and attempting to resolve the complex issues involved in railway costing. Some of the issues,

partly because of the complexity and partly a result of time and data constraints, were not fully resolved by this Commission. We believe these parties have shown sufficient interest in the final outcome of the issues concerning railway costing methodology such that they should be able to obtain the current status of the state of the art.

In an attempt to provide a basis for the CTC to prepare and publish an ongoing report detailing the status of current rail costing methodology, we have included, as part of this Technical Appendix (Schedule I), information regarding the current status of those recommendations brought forth as a result of the 1968/69 Cost Hearings and documented in the Reasons for Order No. R-6313 Concerning Costs Regulations.

The information used to prepare the status report was provided to this Commission, on request, by the Canadian National Railways, CP Rail and the Canadian Transport Commission. It represents the status, reported to this Commission, as of the conclusion of the public hearings into the Cost of Transporting Grain by Rail.

CHAPTER II

REGRESSION ANALYSIS AND ISSUES

Since the latter part of the 1950's, regression analysis has taken on a continued role of importance in costing by both Canadian National and CP Rail. Several memoranda contained in the work and reports of the MacPherson Commission deal at great length with the nature, procedures and results of regression analysis.* These efforts were further reinforced with the findings of the Cost Inquiry (Order No. R-6313, August 5, 1969) and the resulting Costing Manuals of each railway.

BASICS OF REGRESSION ANALYSIS

The use of regression analysis implies an assertion that a certain relationship is expected (or believed) to exist between a set of railway expenses on the one hand and one or more output units on the other. The validity of such an assertion or hypothesis is tested in the process of performing the regression analysis.

An example of one such hypothesis (cited previously) is that the level of wage expenses of yardmasters and yard

---

*Royal Commission on Transportation, Volume III, June 1962. See papers by Wm. C. Hood: "A Note on Multiple Regression Analysis and A Note on Tests of Significance" and D.H. Hay: "The Problem of Grain Costing."

clerks is related to the level of yard switching activity as measured in yard switching miles (or minutes). This relationship is such that if yard switching miles either increase or decrease by a quantifiable amount, the analyst can predict (with some specified degree of confidence) that yardmaster and yard clerk wage expenses will either increase or decrease by a specific number of total dollars.* In this formulation, yardmaster and yard clerk wage expenses are dependent on the number of yard switching miles generated by railway activities.

To "test" this hypothesis, it is necessary to collect the relevant expense data (found in UCA a/c 377) and yard switching mile data for a number of locations or operations of the railway company. While it would be desirable to collect these expenses and corresponding output units for each yard of a single railway company for a specified period, such a procedure is not feasible, because, for most regressions, consistent railway records are maintained only by area (CN) or division (CP). An area or division represents a geographical part of each railway's respective territory and, as such, usually encompasses several yards.

---

*In keeping with the definition of variable costs adopted by this Commission (See Report, Volume I, p. 29) the relationship is assumed to exist only when "all resource cost inputs are optimally adjusted to change."

Simple Regression

In general, the analyst attempts to ensure that each data observation represents homogeneous circumstances and the most disaggregated, consistent data available. The collected yardmaster and yard clerk wage data for each territory (i.e., areas or divisions) and the corresponding yard switching miles generated in each for the same time period form the data set used in the regression analysis. The pairs of dollars and yard switching miles for each territory represents an observation to be used in the test. Table I displays some actual railway data used in this analysis. Similarly, Figure I displays the same information on a two-dimensional graph.

The preconceived belief that the yardmaster and yard clerk wage expenses were related to yard switching miles is borne out by this relationship (broadly described by the shaded area between lines AA' and BB'). Note that observation #4 represents a large wage expense associated with a high number of yard switching miles, while observation #5 represents exactly the opposite.

To this point, the analyst has postulated that yardmaster and yard clerk wages (symbolically, use $W) are related to yard switching miles (use YSM) and the information obtained from company records have borne this out. However,

Table I

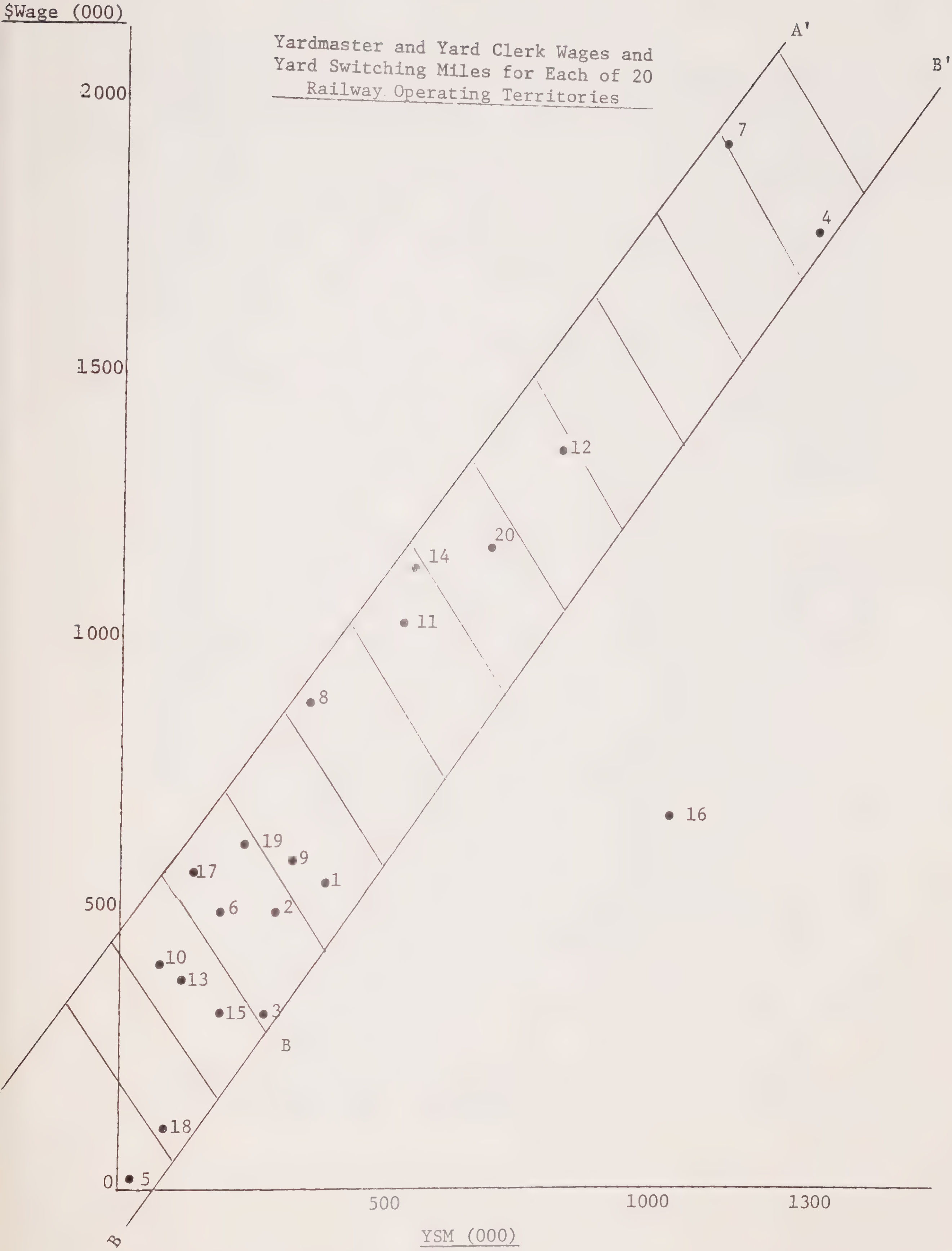
Yardmaster and Yard Clerk Wages and Related Yard Switching Miles

Territory*	Wages ($000)	YSM (X000)
1	$ 598	378
2	506	266
3	346	259
4	1,812	1,288
5	35	**
6	540	198
7	1,996	1,126
8	909	348
9	632	314
10	400	92
11	1,057	508
12	1,376	828
13	370	110
14	1,154	539
15	338	184
16	698	1,041
17	561	127
18	209	38
19	632	240
20	1,219	652

*Because of data source availability, one observation was deleted and two combined.

**Less than 50.

Figure I



Source: Data of Table I. The numbers correspond to the territory number shown in Table I.

the relationship between the two can be either linear (a straight line) or curvilinear. For the present analysis, this chapter will deal only with the straight line situation -- as used in all railway regressions. It can be expected that the straight line which best describes the relationship, postulated by the analyst, will fall somewhere between AA' and BB'. The problem then remaining is to find the line which <u>best</u> fits this scatter of points and which <u>best</u> explains the preconceived relationship. The relationship may be represented by the equation:

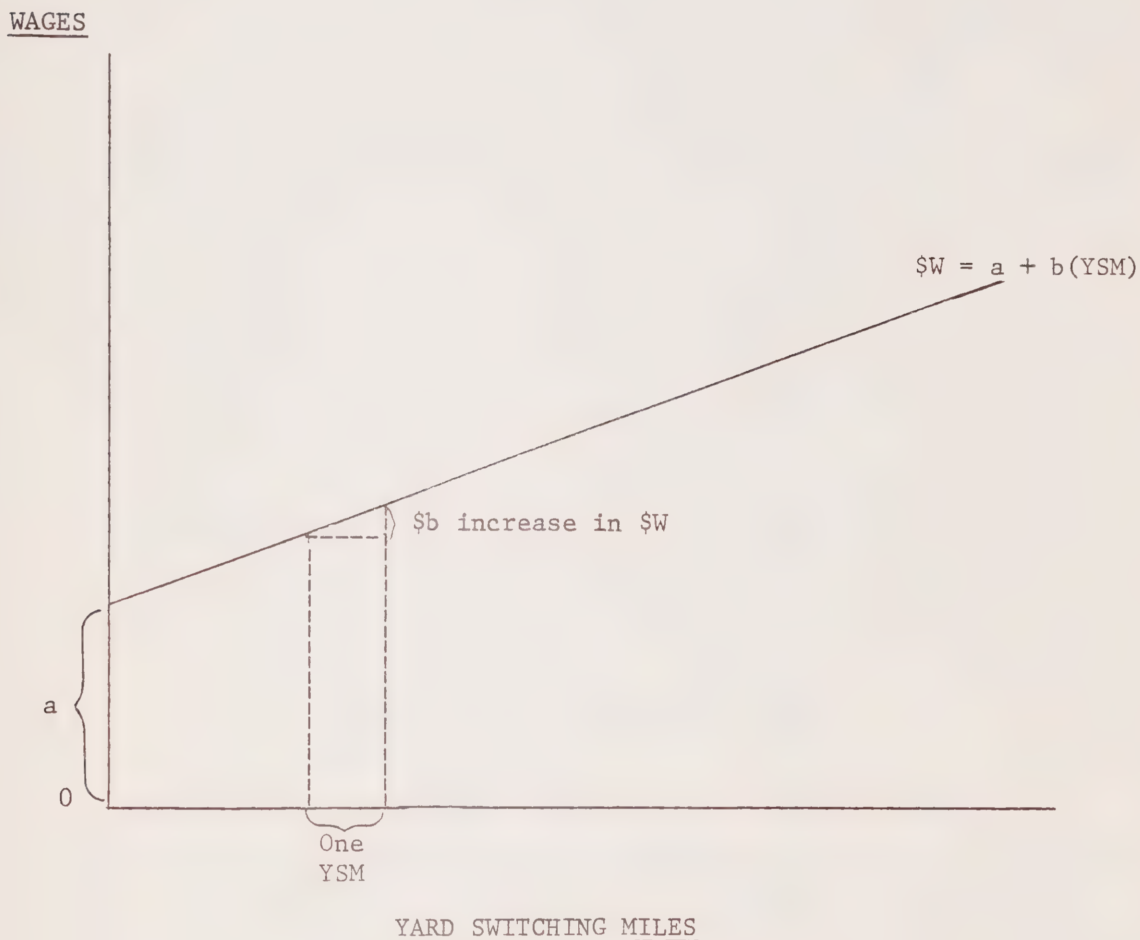
$$\$W = a + b\ (YSM)$$

meaning that the relevant wage dollars for a territory of the company may be predicted by multiplying b (the "unit cost") times the number of yard switching miles and adding 'a' dollars to that answer. Such a prediction may not yield an answer which exactly equals the yardmaster and yard clerk wages for that territory, but will be the best estimation available. While the prediction for any one territory may be over or under the actual by some amount, the prediction for the total 22 territories will be exactly accurate -- the overestimates and underestimates, on average, "cancel each other out."

Figure II shows the relationship represented by the above equation. The coefficient 'a' represents the level

FIGURE II

GRAPHIC REPRESENTATION OF REGRESSION EQUATION



of \$W which is invariant with the level of YSM (referred to as fixed or constant costs). The slope of the line, coefficient 'b', is the change in wage dollars for a unit change in yard switching miles.

In estimating the values of the coefficients of 'a' and 'b' which best describe the relationship between \$W and YSM, the analyst chooses the straight line which, when 'fitted' through the observed points, minimizes the average of the squared values of the vertical deviations of the observations from the estimated line. For example the square of the expression $Q_1 - Q_2$ in Figure III delineates one such squared deviation.* The actual regression line for the Figure I data is shown in Figure III, and represents the relationship:

$$\$W = \$245,000 + 1.22\ YSM^{**}$$

As part of this estimating procedure, the analyst develops a statistical measure known as the coefficient of determination (represented by r^2) which indicates the degree of 'success' in explaining the variations in the dependent

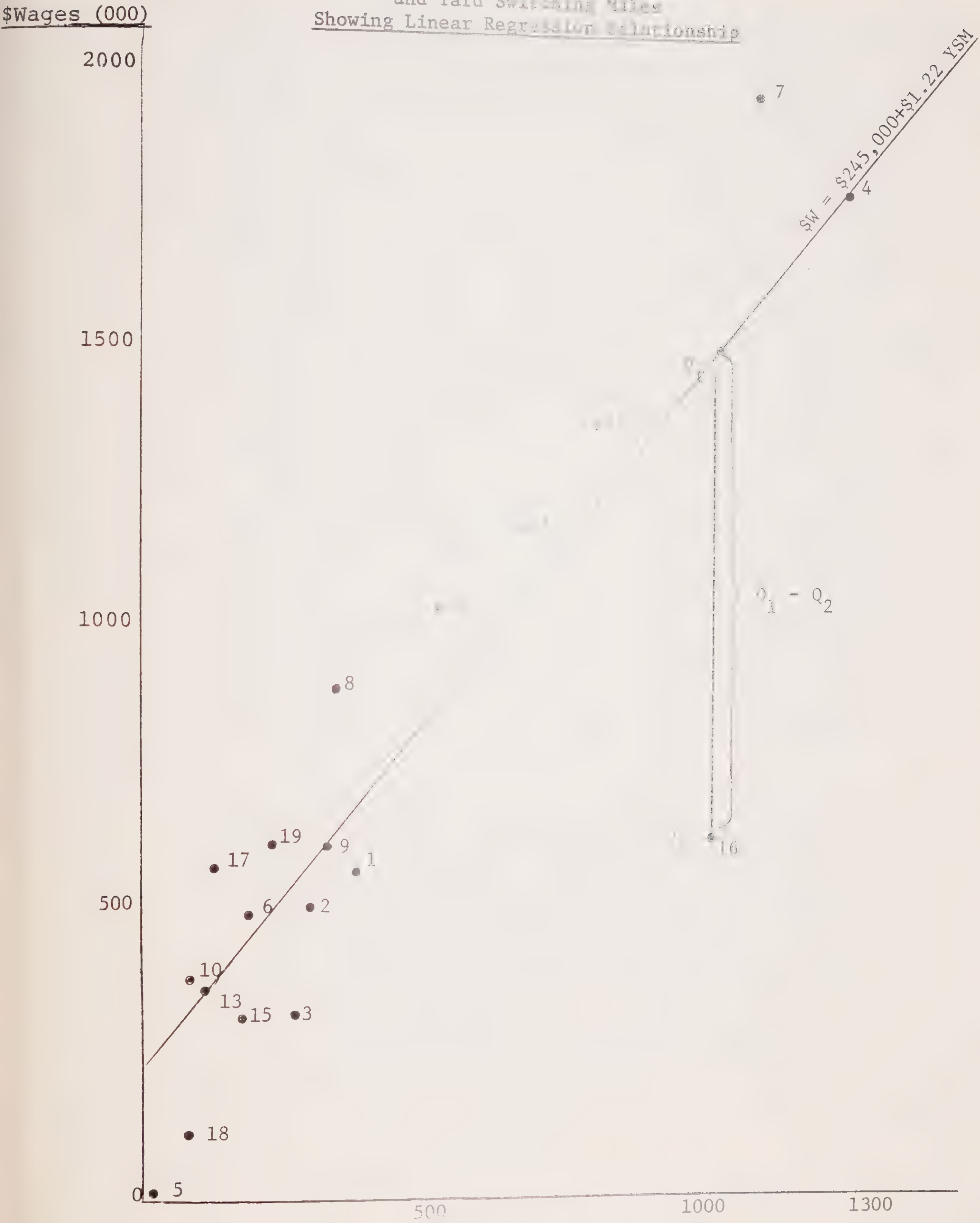
---

*$Q_1 - Q_2$ is known as the residual of the estimate of \$W from the true \$W, for this territory.

**Referring to the earlier discussion, this says that for each territory, the cost of yardmasters and clerks is \$245,000 per division plus \$1.22 per yard switching mile.

FIGURE III

Yardmaster and Yard Clerk Wages
and Yard Switching Miles
Showing Linear Regression Relationship



Source: Date of Table I.

variable (the variable being explained i.e., \$W) by variations in the independent variable (the explaining variable i.e., YSM). If this explanation were perfect, all of the observations of Figure III would lie exactly along the fitted regression line.

The r^2 statistic can take on a value between zero and one. For $r^2 = 0$, the measure indicates that, for the existing data, there is no linear relationship between changes in the values of the dependent variable and the independent variable. When there is a perfect linear relationship (i.e. the case of perfect explanation), r^2 will equal one. With the aid of this statistic, the analyst is able to compare the results obtained from one regression test with those of an alternate test. In this way, it is possible to express some degree of confidence in the acceptance of the hypothesized relationship. However, the testing does not end here.

As noted earlier, the method of estimating a relationship between dependent and independent variables will yield results which, for any one territory, may estimate expenses higher or lower then actual expenses. The statistical technique of regression analysis permits the development of an estimate of the probability that actual expenditures will depart from the estimated expenditure, for each observation, by more than a specified amount. Similarly,

this technique permits the development of probable limits of errors in the estimation of the 'a' and 'b' coefficients. The application of these limits to the coefficients is known as a 't-test'. This testing procedure permits the analyst, with some specified level of confidence (measured in percentage terms), to infer that the regression coefficient reflects a true relationship between the dependent and independent variables; or, alternatively, that the coefficient may simply reflect random influences in the basic data.

It is important to recognize two important implications of this procedure -- particularly since these factors were raised several times during the course of the public hearings of this Commission. At page 219 of the report "The Problem of Grain Costing", D.H. Hay* put this very succinctly:

> Two points should be noted when considering this reasoning. The first is that the statistician does not prove a fact directly. Rather, he eliminates alternatives on the ground that they are unlikely. Having shown that the alternatives are unlikely, he accepts a hypothesis as the most plausible in view of the evidence available. The second point is that the level of significance is subject to the choice of the statistician: he must decide upon the degree of improbability of obtaining certain results which will persuade him that he is not observing the mere operations of chance.

---

*MacPherson Commission, op.cit.

Multiple Regression

An extension of the simple linear regression model is the multiple linear regression. The basic concepts of the two are the same, differing only in the number of output units used to explain the dependent variable -- the expense dollars. In its generalized form, the multiple linear regression is written as:

$$E = a + b_1Q_1 + b_2Q_2 + b_3Q_3 + ... + b_nQ_n$$

where, as before, the 'a' is the constant number of dollars per observation and each 'b ' represents the amount that the dependent expense variable (E) will increase or decrease for each one unit increase or decrease of the output unit (Q).

A concrete example of this approach is the road maintenance complex regression (UCA a/c 202 CX - refers to the total of a/c 202, 212, 214, 216, 218, etc.) which relates the total maintenance expense dollars of a division/area to the miles of roadway (M), gross ton-miles (GTM), yard and train switching miles (YTSM) and degree of grade and curvature (G), of that division/area. In symbols, this relationship may be written:

$$\$Maint = a + b_1(GTM) + b_2(YTSM) + b_3(M) + b_4(G)$$

REGRESSION ISSUES

While reasonably straightforward in concept, the use of regression analysis to determine the unit costs applicable to the rail transportation of statutory grain created several areas of controversy before this Commission. These issues generally can be categorized as those relating to differences of the regression results from preconceived relationships and those relating to the homogeneity of the observations used in the regression analysis.

Regression Results and Preconceived Relationships

The development of unit costs through regression analysis requires that the cost analyst has an a priori formulation of a causal relationship between the independent variable (uaually output unit(s)) and the dependent variable (operating expenses). In other words, the statistical procedure itself does not precede nor predict the specific formulation of the causal relationship. After having stated the expected preconceived relationship, the analyst may reject it on the grounds that the statistical findings of the analysis are inadequate and lead one to have little faith in the quality of the predictions which could arise from such formulation.

Another factor which may lead the analyst to reject the results of a regression analysis arises when the resulting coefficients conflict with preconceived beliefs of the relationships which exist "in reality". Such is the case when unacceptably high estimates for some unit cost coefficients result or when the unit cost (the 'b') is found to have negative values (implying that total costs may decrease as the output of the railway is expanded).

When faced with poor statistical results or improbable numerical results, the analyst may choose one of three options. He may:

- search for a better formulation to explain variations in the expenses
- accept the poor formulation on the strength of his knowledge of "the real world"
- accept the poor formulation but adjust it to remove the undesirable result.

The following sections deal, seriatim with each of the regression issues raised before this Commission which are related to poor statistical results and/or improbable numerical results.

Negative Constants

The negative constant of a regression is represented algebraically as:

$$E = -a + b\ (Q)$$

Taken in its most literal context, this implies that at zero units of output, the expenditure per observation (division/area) is negative -- either a revenue or an expense credit. Figure IV illustrates this relationship.

Standing singly, this may seem a rather odd implication; however, the nub of the matter rests on the interpretation of regression results. It was generally agreed amongst the analysts representing CNR, CP Rail and the Prairie Provinces at the public hearings that the existence of negative constants did not, in principle, cause any problems or uneasiness.* One expert did indicate that he could sympathize with the discomfort that a member of the Canadian Transport Commission might feel in trying to explain the justification for estimated total variable costs for a particular account exceeding actual total expenses** registered in that account (implying greater than 100% variability).

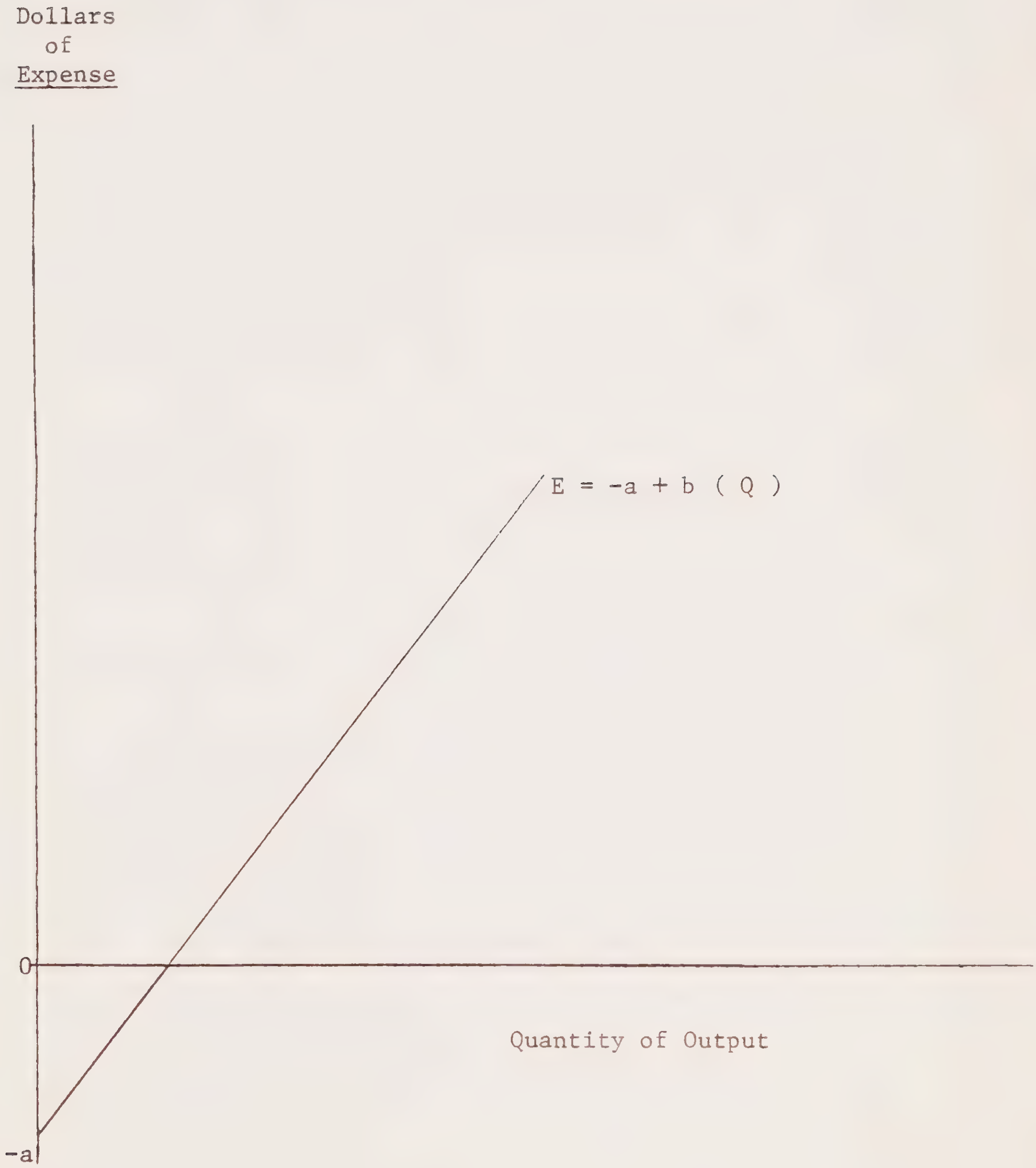
---

*Transcript, Vol. 2, pp. 241-243, Vol. 6, pp. 1000-1001 and Vol. 8, pp. 1420-1423.

**That is, estimated variable costs of b times total output Q results in expenses greater than E, by some multiple of 'a' (dependent on the number of observations).

FIGURE IV

ILLUSTRATIVE REGRESSION EQUATION



In rejecting costs which "appear" to be more than 100 percent variable, the practice of the Canadian Transport Commission has been to reduce all negative constants to zero by rotating the statistically fitted line about the mean of the observations -- resulting in a reduced unit cost (the 'b' coefficient). Figure V illustrates the effect of this procedure. There is nothing which statistically justifies this approach and given the proper constraints on the interpretation of the results, there is nothing in the general body of economics which suggests that it is valid. The initial submission of Canadian National expressed this view in the following fashion:

> Provided they meet the standards otherwise set, regression results implying over 100 percent variability are just as valid and applicable as those whose variability is less than 100 percent. *

In order to put this matter into perspective, it is noted that 13 of a total of 28 regressions utilized by Canadian National and 10 of a total of 40 regressions developed by CP Rail yield statistically fitted straight lines with a negative intercept.

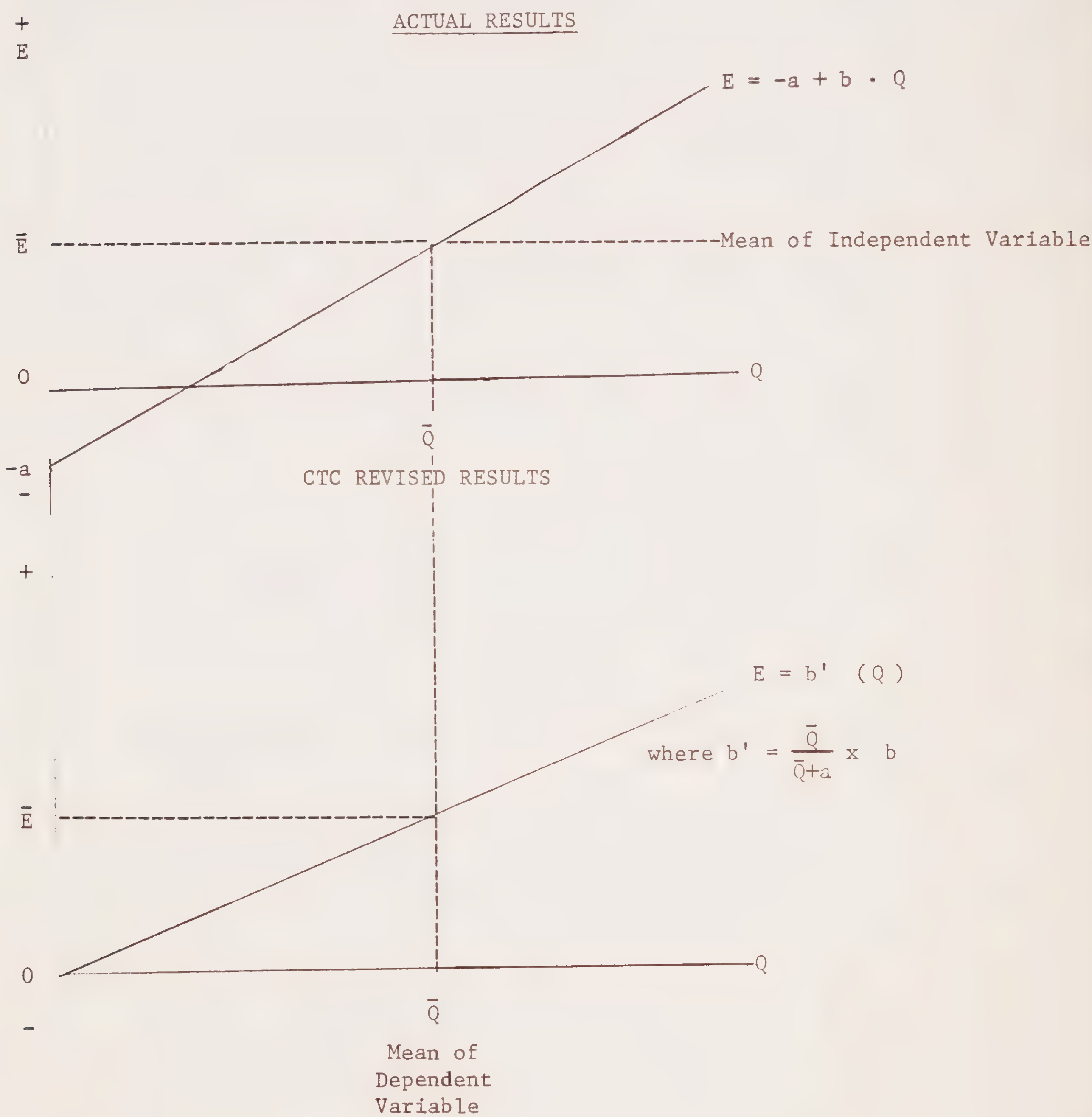
In their initial and rebuttal submissions, Canadian National chose to submit all regression-derived unit costs

---

*Exhibit CN-2, p. 17.

FIGURE V

ILLUSTRATION OF EFFECT OF CTC PROCEDURE OF CORRECTING FOR NEGATIVE INTERCEPT VALUE



without the C.T.C. adjustment for negative constants. CP Rail, on the other hand, chose to submit the adjusted unit costs as derived from application of the Canadian Transport Commission procedure to eliminate negative constants. CN clearly stated that it felt the CTC procedure was "statistically invalid and unreasonable" while CP, under questioning, stated that "in our situation it made more sense to accept the CTC change to the numbers." This position was further clarified by the statement that, in the judgment of CP, "the CTC change did not significantly distort the unit cost figures." *

The essence of the problem of negative constants arises from the misinterpretation of the regression procedure and results derived from regression analysis. The procedure of regression analysis and its attendant statistical tests is designed to measure the relationship between variations in the values of the two variables (in the simple case). In applying regression techniques to railway costing, the analyst is attempting to measure the change in the total costs of an individual expense account, (or group of accounts) as they vary with changes in the level of the chosen output unit. The analyst is not trying to answer the question of how much of this account is variable and how much is fixed, nor what

---

*Transcript, Vol. 2, p. 243.

percent is variable, nor the attendant 'percent variability' criteria -- the measure which the CTC has chosen to utilize as a test criterion of acceptable or unacceptable unit costs.

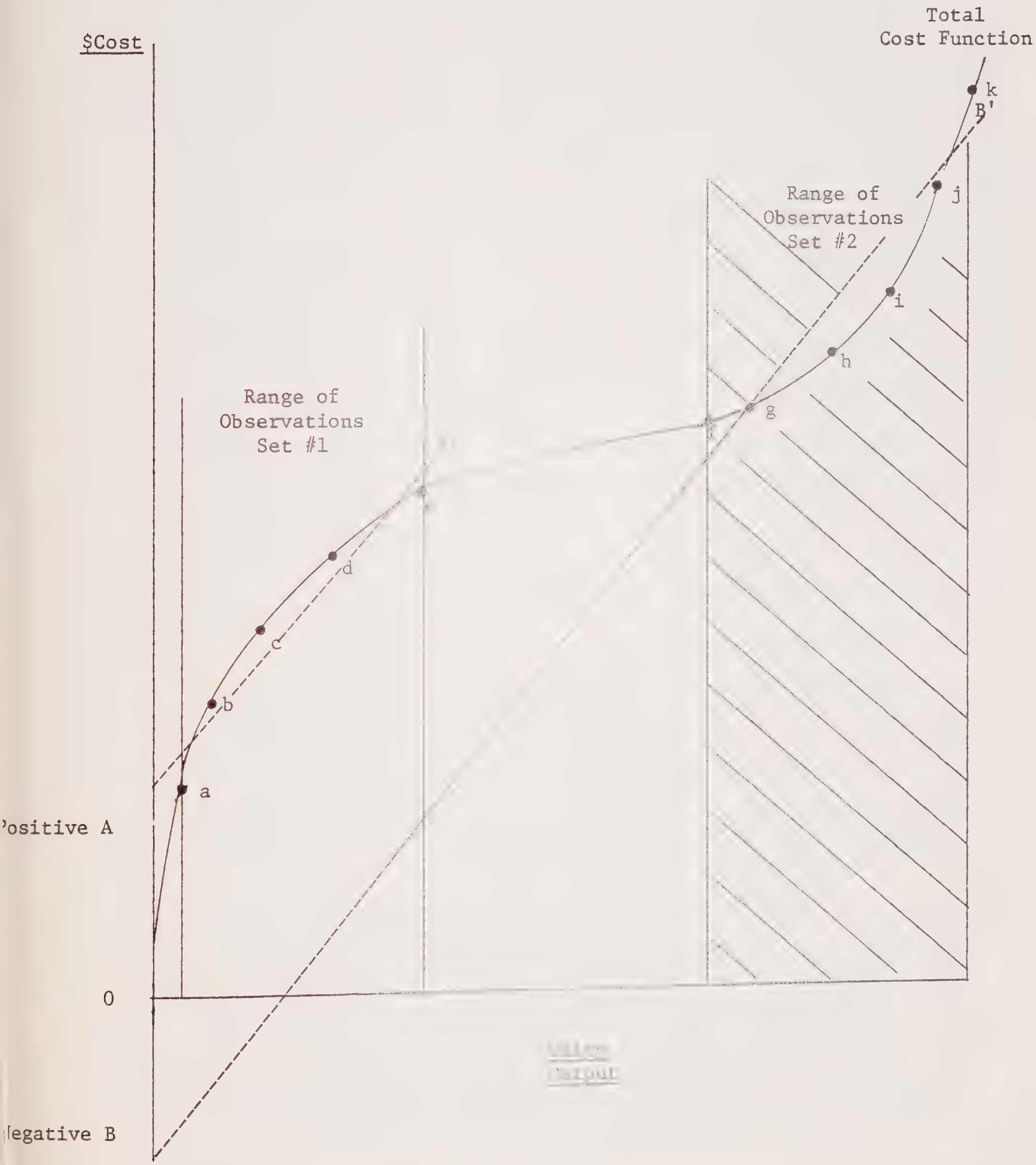
The fitted regression line is an estimation of the true relationship which exists and which is represented by the data. In most instances, a straight line either passing through the origin or with a positive intercept and a positive slope (upward to the right) is the 'best' approximation that is attainable. In a few cases, negative intercepts are observed and some observers begin to feel uneasy.

In the 'normal' depiction of a cost curve, the observation of either of these cases is totally consistent. Figure VI shows such a cost function, which is curvilinear and which has a positive intercept (threshold cost at zero units of output). The curve rises upward to the right at a decreasing rate, then at an increasing rate. The cost-output relationship so depicted describes, alternately, increasing returns and diminishing returns. Stated another way it shows the under- and over-utilization of the available economic capacity.* In fact, a single point on the line

*Over-utilization, here, refers to the fact that the physical constraints imposed by some input resource, prevents the optimum combination of input resources, so that the sub-optimum or inefficient mixture forces costs to be higher and to get progressively higher as further outputs are "squeezed" from the mixtures.

FIGURE VI

NORMAL COST CURVE AND REGRESSSION ESTIMATES



(between under- and over-utilization) represents the optimum output level of the activity represented by the cost function. If the costs observed for each division or area of the railway were 'a, b, c, d, and e' of Figure VI, and the analyst fitted a linear regression line to estimate the cost/output relationship represented by these points, he would achieve a result similar to line AA'. If, on the other hand, the observations were 'f, g, h, i, j, and k', a fitted regression line would appear like BB'. Note that in neither case do 'negative' dollars actually occur and that in both cases, over the range of the observations, the fitted lines fairly estimate the actual dollars which existed in the records of the company. Yet in the first case the intercept is positive while in the second it is negative.* Note, also, that for different ranges of output, constant costs** will appear differently, and will not be universally constant. The fault in looking at BB' and observing a negative intercept which

---

*The results of this discussion are independent of the relative values of the 'b' (slope) coefficients in the two cases -- they could even be equal.

**Constant costs, in the case of a curvilinear cost function, when taken for a specific range of output, are the remaining costs after deducting the analysed variable costs (unit costs times output units) from total costs. They are not invariant, but will fluctuate with varying output levels and ranges of output levels. CN, at page 20 of its initial submission to this Commission (Exhibit CN-2) suggested that the costs referred to as constant, "would more accurately be 'costs which cannot be associated with output units at this level.'".

'ought' to be corrected to reflect only 100 percent variability, is that BB' is only relevant in the range of the actual observations (the shaded area to the right). Also, it may well be true that the cost relationship that is observed as line BB' depicts a sub-optimal operation for this section of the railway with over-utilization of available economic capacity.

This Commission can find no valid reason to accept the procedure of adjusting for negative regression constants adopted by the CTC. As such, all unit costs used in the costing of grain traffic for this Inquiry have been taken unadjusted,* leaving negative constants where they occur -- providing all other statistical and logical criteria were met.

Relevant Range of Observations

The linear regression line, as a representation of the cost experience which actually occurred, is valid only in the range of output observed. The use of these results outside the relevant range of output is, at best, precarious, with the expected error increasing the farther way from the relevant range that one attempts to extrapolate.

---

*In point of fact, it was necessary to recompute those CP Rail regression unit costs which had been submitted to this Commission in the adjusted form (adjusted to reduce 'variability' to 100 percent) as originally approved by the CTC.

The unit cost developed from the regression equation is an estimate of the change in cost of producing one more (or one less) unit of output. Cross-sectional regressions reflect, for the same time periods, the experiences of different sized divisions or areas which perform similar services. In an ideal state, the set of cross-sectional observations would contain the costs of production at every single output level. In its stead, the regression relationship extrapolates the transition from one size of output level to the next.

The range of observations employed by the railways in developing the regression equations raised the issue as to how the results can be applied to a single traffic since that movement, because of its relative size, must, by definition, fall outside the range of the observations.

The response to this concern relies on the notion of traffic density. In one of the discussions during the public hearings, the example was used of a traffic which moved over three subdivisions.* Obviously the number of gross ton-miles generated from the movement would be less than the annual gross ton-miles of the smallest division or area. However, if the average density (gross ton-miles per mile of track) of those subdivisions, taken together, falls between the observed

---

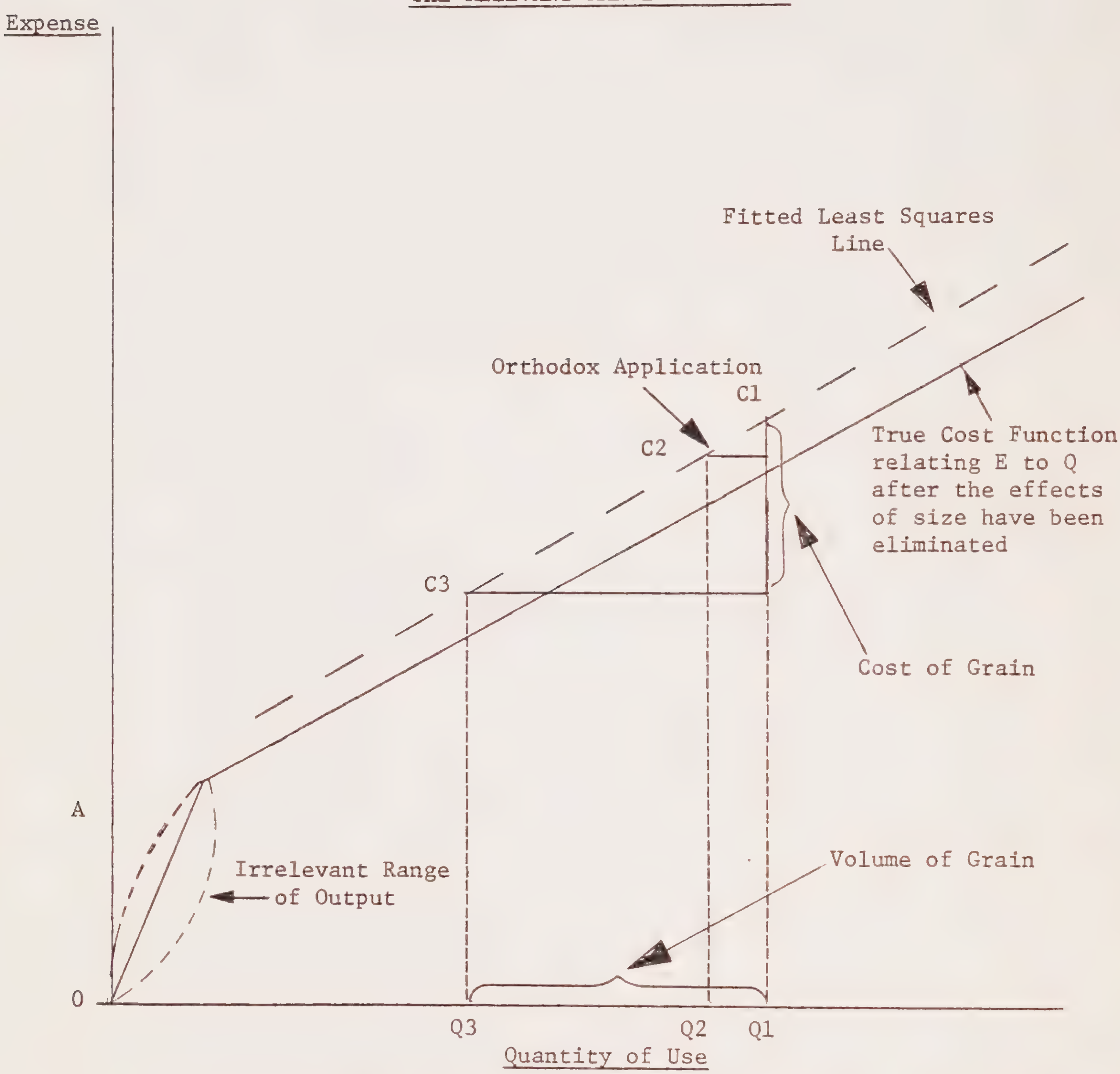
*Transcript, Vol. 24, pp. 4774-4776.

high and low average density of the divisions (or areas) used in the development of the regression analysis, then the costing is still being performed within the relevant range. Similarly for measures such as yard switching miles, train and car miles, diesel unit miles, and others, it is the relative output measures which dictate the ultimate acceptance or rejection of the notion of costing within the relevant range -- not the absolute measures.

In presenting the rationale for the inclusion of only certain fixed or constant costs, the Prairie Provinces included an exhibit which has been reproduced here as Figure VII. A statistically fitted cost function (upper, dashed line) exhibiting constant incremental, and declining average, costs is presented on this graph. Below this line is the 'true' cost function (solid line), which includes a steeper low portion, suggesting that the larger observations (divisions or areas) embody economies of scale, which are not available to, or present in, the smaller observations (this has been labelled the "Irrelevant Range of Output" on the diagram). The unit costs used by both the Prairie Provinces and the railways to develop variable costs, is represented by the slope of the statistically fitted relationship. According to the Provincial presentation:

FIGURE VII

THE RELEVANT RANGE OF OUTPUT



A comparison of a statistically fitted cost function with a "true" cost function.

Source: Exhibit AMS-1, Exhibit No. AMS-N2·2.
Adapted from "The Economics of Competition in the Transportation Industries", John R. Meyer, et al., Harvard University Press, Cambridge, Mass., 1959, p. 38.

> The line represents variable cost at all perceived ranges of output on Main and Secondary Main Lines. In an orthodox application, Volume of Traffic $Q_1 - Q_2$ generates cost $C_1 - C_2$. With its relatively large volume, traffic may be represented by $Q_1 - Q_3$, and its cost by $C_1 - C_3$. Notwithstanding its larger than orthodox conception of traffic volume, grain nonetheless is moved, and costed, in a cost curve range which is linear, or nearly so. This assumption is implicit in the cost calculations of the railways, both as regressed and as directly analyzed, in which cost coefficients of unvarying magnitude are uniformly applied to the traffic, therefore, resulting in unit costs common to relatively larger as well as to relatively smaller volume changes. By contrast, the irrelevant range of output (shown in Figure VII) reflects the curvilinear nature of the lower range of output, which the linear methods fail to capture. This irrelevant range of output is, in the present context, typified by the substantially grain-related subdivisions....*

From this the Provinces concluded that:

> It follows that the variable cost coefficients used by the railways, and the Provinces, uncorrected for size, will overstate the variable costs of the grain movement.**

In this regard, we note that the referenced source for Exhibit AMS-N2.2 of Exhibit AMS-1 (note quoted by the Provinces) actually contradicts the Provincial argument when it states:

---

* Exhibit AMS-1, pp. 12 and 13.

** Ibid.

> The fitted function has been placed above the 'true' function on the grounds that the true or optimal function of economic theory is an ideal that is seldom realized in actual practice. ... This silhouette effect is not apt to be serious in the present instance since its main effect is to increase the statistical estimate of the constant a; this tends to offset the fact that the true value of the threshold costs will be underestimated by the linear constant term since this term results from a simple extrapolation of the regression function back to vertical axis when the correct threshold value would be found by extrapolating a horizontal line to the vertical axis at the point that the minimum marginal costs are first realized... *

In a series of questions and answers between Mr. Saunders and Dr. Borts, at the Winnipeg hearing, the following discussion took place:

> Q. ...I thought perhaps we could also agree that having a series of observations of some scale and producing a regression coefficient, we will then really be applying it to some small or large, but something less than the scale of the total universe from which we drew the traffic we are studying. That would be true, wouldn't it? Typically dealing with volumes or units that are within the scale of observation.
>
> A. In terms of prediction?
>
> Q. Yes.
>
> A. No question of that. Again your error of prediction is going to get very large, if you are thinking of levels of the independent

---

* <u>The Economics of Competition in the Transportation Industries</u>, John R. Meyer et al., Howard University Press, Cambridge, Mass., 1959, p. 37, Footnote 1.

variable which are outside the level for which you originally fitted the relationship.

Q. We are typically not dealing with that kind of prediction problem.

A. That is correct.

Q. So we don't have that obscurity to worry about...

A. That is right.*

The Commission, by utilizing the maintenance of way regressions which separated light density and deferred maintenance subdivisions from the others, avoided the major problem of costing outside the relevant range.

Poor Statistical Results

Two of the options available to the analyst when confronted with poor statistical results for an estimated cost relationship are to reject the relationship being tested and search for a more meaningful formulation of the expense causality or to accept the poor statistical results on the strength of the analyst's knowledge of the manner in which expenses were caused in the real world.

The question of when the analyst becomes "queazy" about the quality of his regression results was the center of some considerable discussion during the public hearing

---

*Transcript, Vol. 7, pp. 1229-1230.

of this Inquiry.* Representatives of the Prairie Provinces felt that certain of the railway regressions were unsuitable and that alternative formulations were better suited to explain the cost causal relationships.

Statistical results, by themselves, are not sufficient to automatically classify one equation as being better than the next. All parties agreed that of equal or greater importance was the "causality" relationship between the independent variables and the associated expense. In exchanges during the public hearing, between the Commissioner and Mr. Romoff and between Mr. Saunders and Dr. Borts, the expert witness representing the Provinces, this truth was clearly enunciated:

> The Commissioner: As a practical matter when the railways submit a unit cost based on a regression which has an r-squared of less than say 30 per cent, or has b values that are not significantly different from zero under the statistical testing, when they submit those unit costs from those equations to the CTC and the CTC approves the unit costs, are you both effectively saying that irrespective of and in spite of the poor statistical showing we are certain or we believe that this is the way to do it and this is the right selection of the independent variables and therefore we are goin to accept it anyhow?
>
> Mr. Romoff: I think we are perhaps saying implicitly that given the data base we have and given all the testing we have done, given all

---

*See, for example, <u>Transcript</u> Vol. 7, pp. 1219-1342.

the thought we have given to choosing other variables, given all we have done to try and specify other models, this seems to be the best that can be done at the present state of knowledge.*

...

Q. (Mr. Saunders): I would like to get to that and I want to be sure I understand the improvement in goodness of fit that obviously played a major role because it was one of the two basic criteria you considered.

A. (Dr. Borts): Right.

Q. When you say "goodness of fit", are you talking about r-squared, or are you talking about a t value, or both?

A. It depends on the number of observations. If you hold the number of observations constant, you can use -- I am sorry, hold the number of degrees of freedom constant, that is roughly defined as observations minus estimated coefficient, you could use r-squared as a rough-and-ready measure of goodness of fit. Otherwise, you would have to use your t values again intelligently interpreted in terms of numbers of degrees of freedom as a measure of goodness of fit.

Q. Probably we could agree that the key words that you just added are fundamentally "intelligently interpreted", which is really what we are always talking about?

A. That is right.

Q. Without trying to be pedantic about it, I wanted to try to sum up in some simple form here what your views might be on the problem of intelligently interpreting data? Would you say that a higher t value with less meaningful data is better or worse than a lower t value, but with more meaningful regression results?

---

*Transcript, Vol. 6, pp. 998-999.

A. I would be willing to trade the more meaningful data for some lesser t value in all cases; in other words, if I could get more specific data, data which was more appropriate for a specific piece of traffic, I would certainly be willing to trade.*

Two-Stage Regressions

In the process of developing unit costs for some accounts by regression analysis, the railways use the expense dollars in other accounts as the independent variable. For CP Rail, this is the case for the following accounts:**

- 201 CX — Road Maintenance Superintendence
- 227 — Maintenance of Stations and Office Buildings
- 253 — Maintenance of Power Plant Systems
- 266-16, 16 1/2 — Depreciation - Stations
- 266-29, 31 — Depreciation - Power Systems
- 302 — Maintenance of Shop and Power Plant Machinery
- 371 CX — Transportation Superintendence
- 16, 16 1/2 — Stations - Cost of Capital (COC)
- 29, 31 — Power Systems - COC

---

*Transcript, Vol. 7, pp. 1223-1224.

**A similar list of accounts apply to Canadian National's regression analysis.

The treatment afforded Maintenance of Station and Office Buildings expense by CP Rail illustrates the process of 'two-stage' regression:

$$MSO = a + b\ (SE)$$
$$SE = c + d\ (CL)$$

where - MSO = Maintenance of Station and Office Buildings Expense

SE = Station Employee Wages and Expenses

CL = Carloads Forwarded and Received

By implication, the relationship of MSO to CL could be written as:

$$MSO = a + bc + bd\ (CL)$$

The question that was asked* was "why do you go through the two-step procedure ... why wouldn't the overhead expense account also be related to the output unit?" In other words, why wasn't the second relationship regressed independently, to yield:

$$MSO = a + b^{1}\ (CL)$$

The rationale for the two-stage analysis primarily rests on the manner in which the analyst believes that the "real world" operates. The specification of the relationship to be estimated through the use of regression is designed to reflect the causative factors which influence the cost. In the case of maintenance and depreciation of station and office

---

*Transcript, Vol. 6, p. 1001.

buildings, it is the amount of activity of station employees, measured by station wages and expenses, which is believed to have the most significant direct impact. It is true that the carloads handled affect the station employee wages and expenses. However, in and of themselves, carloads forwarded and received do not cause nor generate station depreciation and maintenance.

Except as noted in the cases of communication and general administrative expenses, this Commission does not find any need to recommend changes to this two-stage regression approach and finds it to be a proper representation of the causative nature of some railway operating expenses.

Homogeneity of Observations

The Prairie Provinces felt that there was a sufficient lack of homogeneity in some of the data used by the railways to warrant changing some of the regression specifications.* A lack of homogeneity, if it existed, could bias the estimates of variable cost. One of the criteria used by the Provinces in deciding whether to replace a regression was their ability to achieve an improvement in the goodness of fit of the statistical model. The changes that they made to the regression models were:

---

*Exhibits AMS-1, p. 55 and AMS-2, p. 39.

- separation of several expenses between Eastern and Western Canada

- separation of maintenance of roadway between main line and branch line

- combination of Canadian National and CP Rail

East vs. West

The Provinces examined every CNR and CPR regression equation to ensure that peculiar cost conditions of one area or division were not ascribed to traffic which moved only in other areas or divisions. The first step in this process was to examine the residuals of the regressions originally fitted by the railways. By visual examination, the analysts for the Provinces determined whether the pattern of residuals suggested that unexplained costs were significantly higher or lower in the West. Out of this examination, a candidate list of CN and CP regression equations was created for further analysis of potential east-west differences.*

To accomplish this, statistical tests were performed on each regression. These tests involved splitting the observations of each company into an eastern group and a western group. For CN this yielded 10 eastern and 6 western areas; for CP there were 13 eastern and 12 western divisions. The technique used to test for east-west differences incorporates the use of "dummy" variables. In

---

*Schedule II displays the results of the Provinces' analysis of the CN and CP Regressions.

the normal regression equation formulation, a single dependent variable would be explained as follows:

$$E = a + b\ (Q)$$

where E is the dependent expense and Q the independent output variable. For the east-west tests, the following equation was fitted:

$$E = a + b(Q) + c(Q)D + dD$$

where E and Q are as before and 'a' and 'b' are, respectively, the constant (or unexplained) costs and the variable unit costs. D is the dummy variable, which takes on a value of 'O' for eastern observations and '1' for Western observations. The coefficients 'c' and 'd' represent the incremental western variable and constant costs respectively. If the statistical test is performed and each of the 'a, b, c, and d' are found to be significant, the resulting equations would be:

$$\text{East:}\quad E = a + b\ (Q)$$

$$\text{West:}\quad E = (a + d) + (b + c)\ (Q)$$

Under the tests performed by the Provinces a positive 'd' value would imply that constant costs were higher in the west than in the east. Similarly, a positive 'c' would imply that variable unit costs were higher in the west than

in the east.* The statistical significance of each of the coefficients 'c' and 'd' (note that they need not both turn out to be significant) measures the extent to which costs in the east differ from costs in the west. If 'c' and 'd' are not statistically different from zero, one would conclude that no demonstrable differences in constant or variable costs could be found between eastern and western operations.

Seven CN regression equations were tested for east-west differences. Of these, three were found to have statistically different coefficients. Pages 1 and 2 of Schedule III lists the original CN regressions and the replacements suggested by the Provinces. Similarly, twenty of the candidate CP regressions were tested and seven were found to have statistically significant east-west differences. These are listed in Pages 3-5 of Schedule III along with the corresponding original CP regressions.

The criteria employed in accepting the coefficients as statistically significant were:

---

*The opposite would be true for negative signs.

- regional ("dummy") coefficient had to be statistically significant, employing a 5 percent significance level with a two-tailed test.*

- results had to be repeated and accepted with observations for both 1973 and 1974 (and appropriate averaging periods), and the new slope ('b') coefficient had to be significant and of the same sign for both years.

According to Dr. Borts, the Provincial expert witness that sponsored the regression analyses presented in Exhibits AMS-1, AMS-2, and AMS-17:

> it is a relatively stringent test that we have imposed on these East-West differences when we found them.**

The results displayed in Schedule III do indicate some difference in coefficients between east and west for both CN and CP. However, the results also indicate that the differences are not found in the same accounts for each railway. Dr. Borts could not produce any pragmatic reasons for this fact:

---

*For an explanation of one-tailed and two-tailed tests of significance, see Wm. C. Hood, "A Note on Tests of Significance," MacPherson Commission, Volume III, pp. 185-191.

Note that the regression constant was included, regardless of significance level, in the AMS analysis for this analysis.

**Transcript, Vol. 24, p. 4757.

Q. ...I asked what conclusion you come to from knowing that there are two railways when you did not get the same results on both.

A. There could be many reasons why the data would not give us the same results.*

This followed an earlier series of responses by Dr. Borts which, in edited form, included the following:

Q. Would you say from all of that experience that perhaps there's something that some other kind of regrouping ... might have also produced splits between one group and another. ...

A. I could think of other groupings. For example, I could very well think of splitting the branchlines off from the mainlines and running separate regressions and testing those for significance. ...

Q. I am merely trying to get from you the idea that perhaps there is something inherent in any grouping that may produce a few that fit some predetermined grouping, but that many do not. ...For example, if you grouped them according to divisions that have large and small numbers of bridges and culverts, perhaps you would get different results with a dummy variable.

A. You might.

Q. Or the population density per square mile, conceivably?

A. It might, certainly. These things might have some effect on costs and consequently, show up in these regressions.**

---

*Transcript, Vol. 7, p. 1282.

**Ibid., pp. 1246-1248.

In rebuttal to the Provincial position, CP Rail, after citing several reasons and examples in support of their point stated that:

> operating, maintenance and capital investment policies are uniform across the system, and that it is not meaningful, in any way, to segregate such costs geographically.*

In addition, CP stated that it had examined each unit cost (except those that were "system" in nature, and those that were specific to this grain traffic study) for east-west differences. They found that some were higher and some were lower in the west "but that overall, the effect was not significant."**

CP presented a listing of regressions that were tested for east-west differences and showed the dollar magnitude of the difference between actual expenditures in Western Canada and those expenditures predicted by system unit costs. That CP listing has been reproduced as Schedule IV. The column headed "Number of Western Residuals" has been added by this Commission to provide additional information. Note that the number of positive and negative residuals is generally consistent with the West Net Residual

---

*Exhibit CP-39, p. CP-7-R-5.

**Ibid.

Difference,* indicating that the answer contained in this latter column is not unduly influenced by any large residual values (so-called "outliers"). It can be concluded from this analysis that the overall net effect of using system average unit costs on the estimate of Western expenses may result in an overstatement of 1.57 percent for the accounts shown on Schedule IV.

CP Rail also argued that six of the seven regression equations listed in Schedule III were largely related to equipment maintenance -- a function which is more influenced by the location of main repair facilities than by differences in operating policy. For the models chosen by the Provinces for treatment on a regional basis, CP Rail found:

> the result, applied to the relevent output units, is a variable cost of some $200,000 in excess of those costs present in CP-4.**

CP Rail concluded that there was not sufficient evidence to suggest the existence of two sets of heterogeneous data - one for the east and one for the west.

---

*West Net Residual Difference is a single sum of the residuals obtained from the regression results, having regard to the signs in the addition process.

**Exhibit CP-39, p. CP-7-R-8. CP-4 is Exhibit CP-4, which was part of the original CP Rail submission to this Commission.

In responding to the Provincial contention that CN also experiences different unit costs for the east and west, the Canadian National argued that the Provinces had not identified the factors which could logically have some bearing on the costs and which were significantly present in the western areas and absent from the eastern areas or vice versa. In the case of the Yard General and Shop General Expense models (numbers II and III in Schedule II), CN stated:

> the Provinces' case appears to rest entirely on statistical evidence, since no other argument was presented in its favor. The Provinces have, without a priori justification, introduced an additional independent variable, and accepted it or rejected it on statistical grounds alone.*

CN also pointed out that their original set of regressions produced 76 parameters (counting the constants). They contended that the erroneous identification of the significant east-west differences by the Provinces could virtually have arisen from the operation of pure chance. In support of this conclusion they indicated that the creation of a dummy variable to test for east-west differences in each of the 76 parameters produces, under some assumptions,** a 64 percent chance of finding

---

*Exhibit CN-14, p.31.

**CN suggested that assuming each of the 76 was an independent Bernoulli trial would give an idea of the required probability number.

two or more significant dummy variables when, in fact, there is no significant differences.

CN did not compute a listing of regression results comparable to Schedule IV. However, because of its ability to further explain the nature of this east-west debate, such a listing was computed by the Commission as shown in Schedule V.

In response to a request from the Commission, the Provinces included an analysis of CN and CP roadway maintenance separated on an east-west basis in their rebuttal submission. The results of these separations are contained in Table II. On the basis of these results, the Provinces concluded:

> It is clear from these regressions for the two railways that the Western operations differ in some respects from the Eastern operations. It was for this reason that the Provinces decided to examine the allocation of roadway maintenance to traffic in the Western areas alone.*

This Commission fully adopts the concept of developing specific costs where applicable. However, the information presented to this Commission did not conclusively prove the existence of differences in unit costs between the eastern

---

* Exhibit AMS-17, p. 55.

Table II

Roadway Maintenance (202CX)

Regression Results Employing AMS Regional Dummy

CANADIAN NATIONAL - 16 Observations

1. East: $\text{Labour}=1{,}900{,}075+0.1239\cdot\text{MGTM}$ $R^2=0.71$
   $(4.26)\quad(2.36)$

   West: $\text{Labour}=1{,}900{,}075+0.1239\cdot\text{MGTM}+1.4429\cdot\text{YSM}$
   $(4.26)\quad(2.36)\quad(2.36)$

2. East: $\text{Materials}=611{,}394$ $R^2=0.60$
   (3.70)

   West: $\text{Materials}=611{,}394+1.3531\cdot\text{YSM}$
   $(3.70)\quad(4.56)$

CP RAIL - 21 Observations

1. East: $\text{Labour}=325{,}330+0.1228\cdot\text{MGTM}+0.4984\cdot\text{YSM}+617.55\cdot\text{RM}$ $R^2=0.94$
   $(3.07)\quad(7.79)\quad(3.59)\quad(7.10)$

   West: $\text{Labour}=325{,}330+0.1228\cdot\text{MGTM}+0.4984\cdot\text{YSM}+617.55\cdot\text{RM}$
   $(3.07)\quad(7.79)\quad(3.59)\quad(7.10)$

2. East: $\text{Materials}=269{,}903+0.0650\cdot\text{MGTM}$ $R^2=0.81$
   $(3.81)\quad(5.09)$

   West: $\text{Materials}=269{,}903+0.0650\cdot\text{MGTM}+188.78\cdot\text{RM}$
   $(3.81)\quad(5.09)\quad(3.05)$

Note: MGTM = thousand gross ton miles; YSM = yard and train switching miles; RM = miles of roadway.

Source: Exhibit AMS-17, p. 54; all coefficients are significant at the 5% level.

and western portions of the railway operations. It would seem that, in addition to statistical testing for east-west cost differences, there should be an a priori reason for the existence of such differences. That is, an examination of possible differences in eastern and western unit costs should also include an analysis of possible differences in the causative factors between the two operating areas.

In rejecting the notion of different eastern and western unit cost levels for the purposes of costing traffic for this Inquiry, this Commission is not declaring that such differences can not or do not exist. To the contrary, this Commission recommends that the CTC and each of the railways undertake further analysis of the nature and existence of different regression unit costs between different portions or operating sections of the railways -- not confining the analysis to searching for east-west differences alone.

Main Line vs. Branch Line

Table II presented the results of the Provincial examinations of the CN and CP Roadway Maintenance expenses (a/c 202 CX) which led the Provinces to conclude that an assignment of "Western-only" costs would be more appropriate

for the costing of grain traffic. This Commission was not convinced that this information was sufficiently conclusive to warrant the acknowledgement of eastern and western differentiated unit costs. However, on examination of unit costs based on the differentiation between main lines and branch lines appeared more conclusive. As stated by Dr. Borts, many different groupings might yield different results, but the existence of an *a priori* reason for expecting different unit costs to arise from such groupings must always precede such analysis.

One approach taken was to separate the Prairie branch lines from all main lines on the strength of the understanding that

> the branch lines have very light traffic density and small expenditures on maintenance. Much of the branchline mileage is exclusively devoted to grain traffic.*

To perform this analysis, the representatives of the Prairie Provinces deducted the "on branch" maintenance costs and service units from the respective division and area totals to leave a set of observations, for each railway, which reflected normal density railway lines.** The necessary branch

---

*Exhibit AMS-1, p. 59.

**"The cost and operating data thus reflect only main-line traffic and main-line costs." Ibid, pp. 60-61.

line density data for eastern Canada, was not initially available to the Provinces, a fact which led the Provinces to conclude:

> If accurate data for costs and output units, excluding branch lines, were available throughout each railway, more reliable results could be obtained.*

The Provinces confined their initial analysis to Western Canada. This restricted the resulting analysis of CN to six observations and of CP to nine observations, neither one of which was sufficient to afford any meaningful statistical analysis. To overcome this fact, and "because of a different and more fundamental opportunity to make the observations homogeneous,"** the Provinces' analysis combined CN and CP western main line observations to develop the following roadway maintenance (labor and materials combined) regression result:

---

*Ibid., p. 55. Such data was made available to the Provinces for subsequent analysis.

**Ibid., p. 59.

Table III

Western Main Line Roadway Regression
CN and CP Combined; Labour and Materials Combined

$$\$M = -541{,}069 + .1894(MGTM) + 1.2926(YTSM) + 1613.2855(RM)$$

T Values = (1.70) (1.16) (1.53)

MGTM = thousand gross ton miles
YTSM = yard & train switching miles
RM = roadway mileage

number of observations = 15

$r^2 = 0.66$

The quality of this regression was such that the Provinces felt it superior and chose to utilize it in their costing analysis. Table IV lists the statistical results obtained in each of the original railway regressions, showing that the Provincial regression is not significantly superior to the overall railway results, however its specificity makes it somewhat attractive. In total, this Commission was interested in the results as obtained by the Provincial representatives and presented at the Winnipeg hearings.

Table IV

Statistical Results of Original Railway Regressions
Maintenance of Roadway

	# Observations	r^2	T-Values			
			MGTM	YTSM	RM	GI
<u>CN</u>						
Labour	16	0.71	3.16	1.47	1.96	0.43
Material	16	0.54	2.43	1.36	1.23	0.84
<u>CP</u>						
Labour	21	0.96	9.10	3.80	1.30	2.40
Material	21	0.82	5.30	1.40	0.01	1.20
<u>Provinces</u>						
Labour + Materials Combined	15	0.66	1.70	1.16	1.53	----

where MGTM = thousand gross ton-miles.
YTSM = yard & train switching miles.
RM = roadway mileage.
GI = gradient index.

In light of these results, CN decided to produce a new regression equation for roadway maintenance which excluded, as far as possible, the data which pertained to branch lines having abnormal maintenance levels.* This excluded, from the 16 CN areas, all data relating to subsidized lines and lines which were under abandonment applications. CN conceded that:

*Abnormal, here, was interpreted to mean low.

> While this may not constitute an exhaustive list of lines on which maintenance has been deferred, it is considered to cover a sufficient proportion of such lines for the present purpose .. It was assumed, however, that all lines for which 1974 subsidy data were available had an abnormal maintenance level.*

The results of this new regression are shown in Table V and may be compared to Table IV for an evaluation of the statistical results.

Table V

CN Roadway Maintenance Regression Excluding Low-Density Lines with Sub-Normal Maintenance

Labour =	-1,509,291	+ 0.11766 (MGTM)	+ 0.07181 (YTSM)	+ 1479 (RM)
T-Value =	(0.42)	(2.06)	(1.87)	(2.43)
$r^2 = 0.69$				
Material =	-2,618,330	+ 0.05801 (MGTM)	+ 0.03134 (YTSM)	+ 558 (RM)
T-Value =	(1.23)	(1.73)	(1.39)	(1.65)
$r^2 = 0.56$				

Note that the gradient index has not been used, since it "would have been difficult to calculate for the subsidized lines and since it is insignificant in any case." Exhibit CN-14, p. 53.

Dr. Borts, representing the Provinces of Alberta, Manitoba and Saskatchewan, when asked about the new CN regression, responded:

---

*Exhibit CN-14, pp. 51 and 52.

Dr. Borts: I rather like it.

The Commissioner: When you say you rather like it can I conclude from that that you would accept that as a regression equation for the roadway maintenance complex main line or non-deferred maintenance lines for the CN system on the average?

Dr. Borts: Yes, I would.

...

The Commissioner: Dr. Borts, as a professional statistician and economist ...looking at that material and the various other material you have looked at regarding the roadway regressions and the 202 complex regressions, can I as the Commissioner in my costing for movements not (sic) on the deferred maintenance line use that equation with some reasonable feeling of security that I have a decent estimate of the cost?

Dr. Borts: Yes.*

CP Rail also carried out some tests of the hypothesis that deferred maintenance on certain lines may distort the roadway maintenance regression. However, this was accompanied by the following statement of position:

CP Rail does not accept the concept that regional regression models should be developed for Eastern and Western Canada separately, nor does it accept the concept that useful results can be achieved by pooling data for both railways. Also, while acknowledging that the gradient factor used by CP Rail has certain imperfections, it is the position of CP Rail that it does help explain a major factor of road maintenance expenses.**

---

*Transcript, Vol. 24, pp. 4758 and 4759. Word in transcript was incorrectly reported as "now".

**Exhibit CP-39, p. CP-6-R-2.

In performing the tests, CP used observations for the 21 divisions of the system, from which the branch line data (maintenance expenses and operating statistics) for lines having deferred maintenance were removed.

It should perhaps be noted that the Provinces chose the subsidized lines as the non-homogeneous element of roadway maintenance because of their relatively low density (gross ton-miles per mile of track). CN referred to "Low Density Lines with Sub-Normal Maintenance" and chose the list of subsidized lines and lines under abandonment applications as synonymous with this definition. CP chose the subsidized and abandonment application lines "as well as other branch lines which, in the view of CP Rail, have deferred maintenance."* Dr. Borts pointed out this distinction in the approaches of the three parties:

> Our argument is that the branch lines have been removed from the sample because of the light density of traffic. We have not claimed that the lines so removed are under-maintained.
>
> Nevertheless, I am quite pleased that both railways, for whatever reason, have seen fit to purify their sample and many of their results, I think, are results which I personally could accept....**

The results of the CP tests are summarized in Schedule VI. The statistical results of these tests can be compared

---

*Ibid., pp. CP-6-R-2 and CP-6-R-3.

**<u>Transcript</u>, Vol. 24, p. 4666.

to the original CP regression results contained in Table IV. The results of each of the tests are only marginally different than the original CP regression -- except Test 1 (materials) which has an unacceptable negative coefficient. When asked to comment on these, Dr. Borts answered that the results of either of Test 2 or Test 3 appeared acceptable and that an examination of the coefficient of variation would permit one to conclude which test was preferrable for use in costing of the grain traffic.* These coefficients of variation have been included in Schedule VI and lead to the conclusion that Test 2 provides results superior to the original CP results.

With respect to investment, Volume I of this Report states, on page 141:

> Neither the Provinces nor CP Rail developed roadway property gross investment or depreciation unit costs for the lines without deferred maintenance. The Commission did compute their unit costs through regression analysis. This analysis produced statistical results superior to CP Rails' regression analysis for all system lines.

The Commission excluded from its analysis all lines in Eastern and Western Canada which were identified by CP Rail as deferred maintenance lines. This allowed an analysis to be performed on non-deferred maintenance lines (predominately main lines). Schedule VII reproduces the results of the

---

*Ibid.

regression analysis undertaken by the Commission to determine road property gross investment and depreciation for non-deferred maintenance lines only (page 1) and the results of CP Rail's analysis to determine road property gross investment and depreciation for all CP Rail lines including (page 2) and excluding (page 3) the gradient index as an independent variable. The statistical results of the Commission analysis were comparable with the results obtained by CP Rail when they used data for all lines. Also, the Commission felt that employing specific data for only non-deferred lines achieved a greater degree of specificity for the study. Consequently, the Commission used the results of its regression analysis to determine roadway property investment and depreciation expenses in the tabulation of the total costs of transporting grain by rail.

In the course of analysing the value of separating the data for the deferred maintenance and non-deferred maintenance lines for purposes of computing unit costs for roadway maintenance, depreciation and gross investment, the Commission also isolated the data for the grain dependent lines. The Commission undertook regression analysis of these data to determine if the statistical results would be significant and could possibly be used by the Commission in the determination of its total cost estimates. However, the low t-values, negative regression coefficients and generally poor statistical results obtained from the regression analysis on grain dependent

lines alone, prevented their use for purposes of this study. While these results have not been used in the Commission's final cost computation, the results do prove interesting and are reproduced as Schedule VIII.

CN and CP Combined

Over the past decade, it has been argued, at various times* that data for both CN and CP should be combined to develop railway system costs, rather than railway company system costs. During the course of this Inquiry, the Prairie Provinces used this approach in estimating normal density roadway maintenance costs. This "different and more fundamental opportunity to make the observations homogeneous" was based on the strength of the argument that

> If the two railways are equally efficient and their operations physically similar, then their cost records and statistical observations could be combined to permit estimation of a single unified set of cost regressions.**

By combining the two railways, it is possible to test, through the use of dummy variables, whether the two are significantly different in their operating and cost characteristics. In their initial submission, the Provinces stated:

---

*See, for example, "Submission of the Provinces of Alberta, British Columbia, Manitoba, Ontario, Quebec, Saskatchewan and the Maritimes Transportation Commission to Railway Transport Committee, Canadian Transport Commission, in the matter of Railway Costing Procedures and Related Matters, August 1968," p. 102, recommendation #1.

**Exhibit AMS-1, p. 58.

> ...The Provincial experts have carried out such a study, but only on one of the expense accounts--the Road Maintenance Complex (Account 202, etc.). The Provinces did not deem it advisable to carry out such a study for the other accounts because the CNR accounting system has led to a fragmentation of account identities. It seemed virtually impossible within the time limits to reconstruct other CNR accounts so that they would be comparable with CPR accounts. *

As was outlined in the discussion of East/West differences, the same type of statistical test, imploying dummy variables against CP and CN observations, was carried out by the Provinces. In this case CP Rail observations had a dummy variable of "0" and CN observations had a dummy variable of "1". As was explained in the East/West section, if the coefficients were not statistically different from "0" then there was no proof that the two railways were different and "The two railways can not be considered a single firm for costing purposes."** The regression analysis on roadway maintenance expenses which resulted from the Provinces using combined observations from CN and CP were shown on Table III. In these results, none of the coefficients which would indicate differences between the two railways was found significant at the five percent level. This led to the conslusion that, statistically, the roadway maintenance regression results are unable to prove that the railways are different. This is not

---

* Exhibit AMS-1, p. 59.

** Exhibit AMS-17, p. 56.

equivalent to proving that the two are the same.*

The railways questioned Dr. Borts on the possibility that:

> Something obviously is happening and we are not explaining it if we just take all of them and treat them as a homogeneous collection of observations.**

In order to examine this, the railways introduced Exhibit R-6, which is reproduced here as Figure VIII. This exhibit arrayed the percentage calculation of the residuals obtained from the regression proposed by the Prairie Provinces.

> Q. ...I am also suggesting you are merely taking the group and treating them as one homogeneous group because statistically your averages tested significantly may be obscuring something more than just where they happen to be. The physical geography.
>
> A. I would never rule out the need for more experimentation with this data.
>
> Q. Let's turn to the right-hand side of the chart and consider a little bit the variations there. First could we agree that there is more scatter of the CNR observations than there is of the CP observations?
>
> A. Certainly.

---

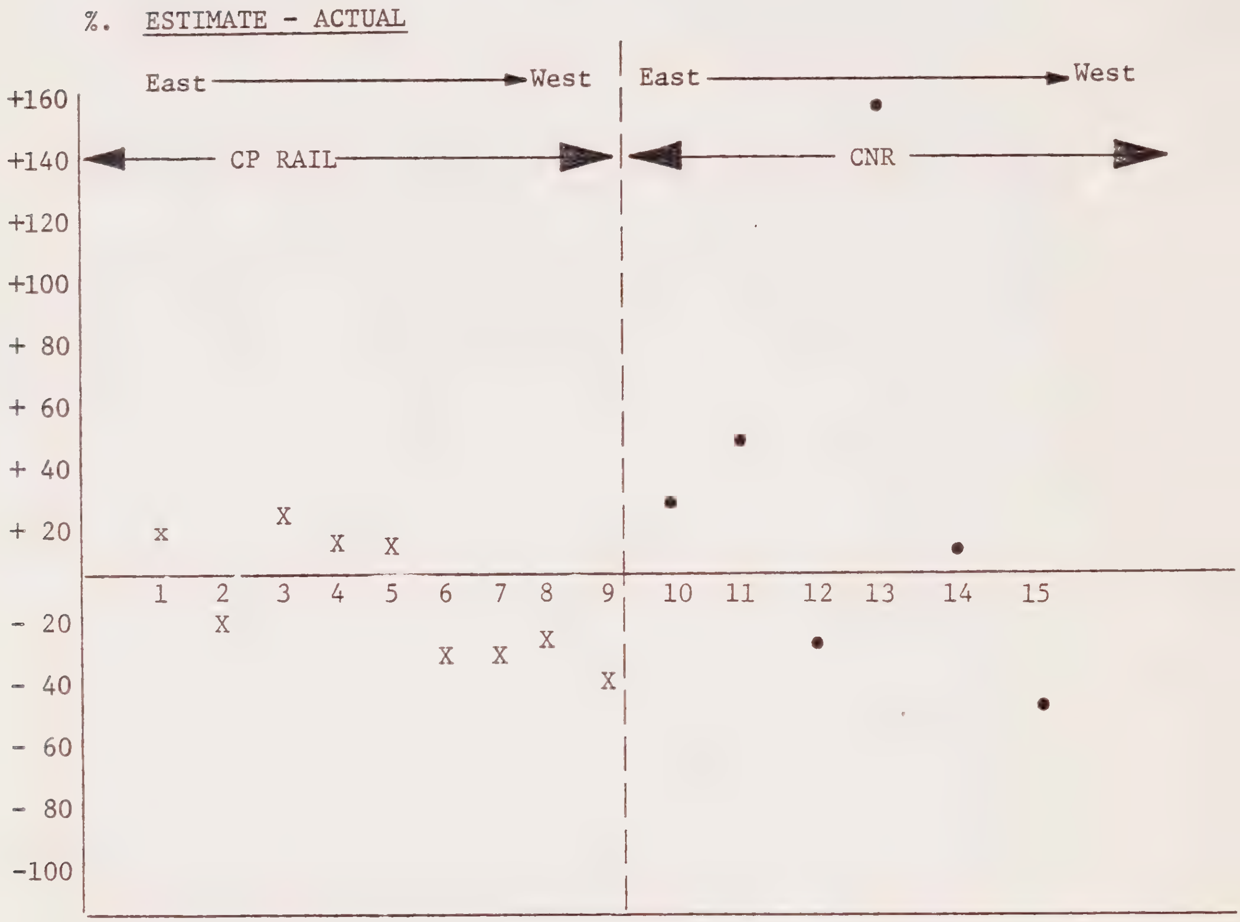
*Transcript, Vol. 24, pp. 4784 and 4785: Dr. Borts and the Commissioner had the following exchange:

"Dr. Borts: ...it is much easier to hypothesize they are the same...
Commissioner: I understand, but in the end you have not proved they are the same. You have only proved that you cannot prove they are different.
Dr. Borts: That is right."

**Transcript, Vol. 7, p. 1326.

FIGURE VIII

RESIDUAL PLOT OF THE ACCOUNT 202 CX REGRESSION AS COMPUTED AT PAGE 61 OF EXHIBIT AMS-1 (TAKEN FROM EXHIBIT R-6)



1. Thunder Bay-Winnipeg
2. Brandon
3. Saskatoon-Moose Jaw
4. Alberta South
5. Alberta North-Calgary
6. Revelstoke
7. Canyon
8. Kootenay
9. Vanvouver
10. Lakehead
11. Assiniboine
12. Hudson Bay
13. Saskatchewan
14. Alberta
15. British Columbia

Q. Would that make you feel that perhaps they are not equally homogeneous with those of the CP?

A. Possibly.

Q. Right. Even though a test using a dummy variable and using t's would show that in the aggregate you have a satisfactory result, there may still be something else going on that the test of relevance might make you queasy about?

A. Certainly.*

Aside from the agreement that the residuals had distinctly different patterns for CP Rail and CNR, it was suggested that this pattern could have some relationship to the fact that grade and curvature were changing as one moved from left to right (east to west) on the exhibit. This led to the suggestion that the failure of the Provincial regression equation to include a grade index partly explained this apparent residual pattern.

On the strength of the information presented to this Commission, it was not possible to conclude that sufficient similarity exists between the operations and costs on CN and CP to justify the combination of the two for the purposes of developing uniform or average unit costs of operation. The aim of greater statistical accuracy,** while desirable, is

---

*Ibid., pp. 1326-1327.

**"From the point of view of accuracy in statistical estimation, the advantage is greater assurance that the estimates are reliable, for a larger number of observations generally imply reduced sample variances." Exhibit AMS-1, p. 58.

insufficient to transcend the more fundamentals issue of the desireability of combining the data from the potentially heterogeneous operations and costs of two railway companies who happen to be in the same homogeneous operation called 'grain transportation.

It should be noted that the grade index, as it is now specified in the regression equations, differs somewhat from that which was presented to the MacPherson Commission.* Some eight years later, it was stated in reference to the 202 complex and grade and curvature at the time of the Cost Inquiry:

> "Both railways, however, are continuing further analysis of this complex." **

Given the evidence presented to this Commission and the impact of including a grade and curve index in the estimation of roadway maintenance expenses as applied to the costing of grain transportation, the Commission finds that the inclusion of a grade index, as presently formulated, in the account 202 complex regression is inappropriate. This Commission is fully in agreement that an index of grade and curvature can be used to explain different roadway maintenance costs per mile and different roadway maintenance

---

*Ibid, D.H. Hay, "The Problem of Grain Costing" pp. 229-250 contains a summary of the effort at that time.

**Reasons for Order No. R-6313, p. 337. See also, pages 6.215.02 of the CN and 8.015.5 of the CP Costing Manuals.

costs per gross ton mile. However, as it affects grain transportation costing, this Commission finds the present specification of grade and curvature to be inappropriate and also finds the present application of the existing grade and curvature index to be inappropriate. Inasmuch as this finding has impact on the costing of other traffic as well as export grain, it is recommended that the railways work with CTC to:

- develop a more meaningful and statistically significant measure of grade and curvature that reflects differing roadway maintenance cost causation.

- reformulate the manner in which the grade and curvature index are introduced into the roadway maintenance cost regression.*

---

*Note that D.H. Hay, at page 246, Volume III, Mcpherson Commission, finds: "It is interesting to note that the effect of introducing this new variable was to reduce the coefficients for miles of road to about half their previous values, while similarly lowering the explanatory power of these values. This suggests that a future programme of research might include an investigation of the weighting of miles of road and the grade index."

CHAPTER III

NORMALIZATION OF COSTS

Three distinct aspects of the cost normalization issue were presented to this Commission. The first aspect, and the one least contested by the parties, related to the general practice of using expense data which was averaged over a period of two or more years in the development of the variable unit costs. The second aspect concerned the applicability of specifically developed normalized maintenance and capital costs. The third involved rehabilitation costs.

NORMALIZATION OF EXPENSE DATA

Approximately two thirds of all railway variable cost analyses involve the use of data for more than one year. Schedule IX lists the normalization periods used by CP (page 1) and CN (page 2). The reason for normalization is that expenses recorded in the accounts of the company during a single year may not reflect or be caused by the transportation services provided or work units generated by the railway during that year. For example, the maintenance work on the roadway in one year may be the result of higher wear-and-tear identifiable with unusually high traffic volumes of a previous year.

In order to be more representative of long-run cost relationships and in order to avoid short-term impacts, the

expense accounts and related output units used in the specific analysis are averaged for several years -- a number sufficient to avoid short-term fluctuations. Labour and material price indices are computed for each year of the normalization period and the relevant index is applied to the dollars of operating expenses used in the regression and direct analysis procedures. The procedure is fairly straight-forward and involves a recognition of the effects of inflation, i.e., the fact that one dollar spent last year is not equivalent in purchasing power to one spent this year.

The normalization procedure does not, however, recognize the fact that purchasing one unit of an input factor -- even in constant dollars, does not imply the purchasing of a constant productive capacity. In its simplest terms, even if the generalized effects of inflation are removed, the normalization procedure does not remove the effects of technological change and changing productivities. In averaging three or five years together the resulting data observations are susceptible to the problems of non-homogeneity. As such, the beneficial impacts of productivity improvements and the disbenefits of physical operating constraints become diluted by the non-homogeneous relationship of other years.

The nature and importance of this problem has not escaped the railways. During cross-examination in the

Winnipeg hearings of this Commission, the following exchange took place between the Commissioner and Mr. Romoff of CP Rail:*

> Q. ...would you presume first of all, Mr. Romoff, that even over a period of time as short as 3 or 5 years there are some increases in labour productivity?
>
> A. ...It is a problem or a situation rather that we are most aware of and we have given a fair bit of thought to what is the best way to deal with productivity in this normalization process. There is no doubt on a gross basis, on an aggregate basis there have been productivity gains within the railway as measured by such things ... as gross ton miles per employee ... the broad measures of work done per employee or employee hour on the railway have been going up.
>
> It is clear to us that the gains arise primarily, in recent years at least, if not entirely in changes in the operating practices or in the technology of the railways...
>
> This certainly is a very important issue. The whole concept of changing mix ... The impact of operating larger cars, ... The impact of gradually shifting our mainline power to 3000-horsepower diesel engines (have) had a tremendous impact upon ... gross productivity measures. Also, of course, since railway costs are not 100 percent variable, as volume increases gross measures of productivity will become better.**

In order to examine the effect of productivity changes,

---

*Transcript, Vol. 6, pp. 979-985. Quoted passages here are edited to highlight the colloquy.

**Op. Cit., pp. 979-981.

CP Rail has undertaken several tests, looking at each year individually -- specifically with respect to deflated diesel repair costs per mile and deflated car and repair costs per mile and day. The conclusions reached, to date, have been that:

> there is certainly no trend of any kind that is apparent from these numbers. ...some up, some down, no change, but no trend of any kind to indicate improved productivity at the unit cost level.*

For the purposes of costing the grain traffic, this Commission has adopted the railway procedures of averaging price-normalized cost observations. This Commission does not find any fault with the price indices as developed by the railways. However, in so doing, the Commission recognizes that this will result in some misstatement of actual 1974 costing, due to the incorporation of railway operating practices and technology for years 1970, 1971, 1972, 1973, and 1974 into a single averaged observation -- years in which improvements in productivity probably have occurred. To date, it has not been demonstrated that the individual unit cost/output unit combinations will result in variable costs which are biased either up or down, though the existence of general railway productivity improvements is conceded.

---

*Ibid, pp. 982 and 983.

NORMALIZED MAINTENANCE AND CAPITAL COSTS

In their original submission, both railways included costs to cover the estimated expenditures for rehabilitation of the grain dependent branch lines to a minimum standard and for an ongoing maintenance and capital replacement program to maintain these specific lines to that standard.

Once a rail line has been constructed, the railway company must then design and undertake a maintenance program to maintain the line to the desired standard. The maintenance program is designed so that the amount expended by the company equals the amount of deterioration which occurs in the line over a given period of time. Thus, the line is maintained or kept to the original or desired standard.

The maintenance program consists of two separate expenditures for purposes of railway accounting. One expenditure is recorded as road maintenance and includes all repair expenditures and purchases of, and charges to, road property which are less than $1500. All road maintenance costs so defined are charged to expenses:

> When road property (other than land and tracks) is acquired, the cost of which is less than $1500.00 the cost shall be charged to expenses. When a property change involves the replacement of a unit of road property and such replacement

cost is less than $1500.00, the replacement cost shall be charged to expenses.*

The other portion of the maintenance program is entitled capital replacement. This cost consists of all expenditures on road property over $1,500.00. These costs are then capitalized and depreciated over the life of the asset. For instance, if the railway installed $40,000 of rail with no expected salvage and with an average life of 40 years, then the company would be able to depreciate, and therefore charge as an expense for that year, 2.5 percent of the initial cost i.e., $1,000. If, on the other hand, these costs were treated as expenses the entire $40,000 would be claimed as an expense for that year.

A maintenance program which would maintain lines to a specific desired level has not been performed by the two railway companies on the grain dependent branch lines for a period of many years prior to 1974. Instead, the railway companies had been deferring maintenance on the majority of these lines. That is, deterioration was taking place at a quicker rate than the maintenance program replaced or repaired the line.

---

*Accounting Circular No. 11, March 20, 1974; Railway Transport Committee, Canadian Transport Commission.

The railways approached the development of their cost calculations on the assumption that the grain system being costed was to be ongoing and not treated as one going out of business or being liquidated.* That is, both companies submitted cost calculations which included a normal maintenance and capital replacement program for the lines designated as being dependent on grain transportation.

Normal maintenance and normal capital replacement is the amount of expenditure required to maintain a line to a desired standard. As such, the amounts involved differs from the amounts the railway companies actually spent in 1974 on the grain dependent lines but are equal to the amount of deterioration** which occurred on these lines in 1974. Both railway companies developed their estimates for normalized maintenance and capital costs as a minimum standard for the traffic volume offered:

> ...CP Rail, in this paper, has developed estimates to bring these lines to only the minimum standard necessary to ensure their continued operation and to sustain them at this level.***

---

*This concept of the system was adopted by all parties.

**As noted elsewhere, this Commission viewed resource consumption as the true measure of costs -- not accounting expense entries.

***Exhibit CP-8, p. 1.

Normalized maintenance and normalized capital expenditures were calculated by the railways, assuming that the grain dependent lines had been maintained in all previous years to a "minimum" acceptable operating standard. That is, they determined a level of expenditures that would be required to maintain the lines at an ongoing level. To approximate the amount required to implement a "normal" ongoing maintenance and capital replacement program, the railways undertook engineering studies which approximated the average expenditures required for such a program. The results of the respective studies did not attempt to reflect the specific cost for any particular line but, rather, developed an average cost per mile for all lines in the grain dependent category.

Normalized Maintenance

The method of calculation of normalized maintenance was the same for both railways. They first developed a cost per mile from their engineering estimates which was then applied to the total miles of grain dependent lines to produce the total normalized maintenance expenditures. This total was then compared with the actual maintenance dollars expended in 1974 on the grain dependent lines. The difference between the two amounts was termed the maintenance shortfall and was included in the roadway adjustment cost category.

CP Rail found that the Tisdale Subdivision incurred an actual maintenance expenditure in 1974 that was greater than the calculated normalized figure. This one maintenance expense was subsequently reduced to the normal figure. CN similarly identified three lines in that category (the Carberry, Battleford and Stettler subdivisions) and performed a similar adjustment. Canadian National also identified the Herchmer subdivision in this category but did not adjust this latter expense downwards to the normalized level. *

While the Provinces did not include normalized maintenance in their initial submission, their rebuttal submission stated:

> ...the Provinces do not dispute the fact that the 1974 cost (by whomsoever incurred) of transporting statutory grain would include one year's normalized maintenance of substantially grain-related lines rather than the presumably lower actual expenditures for maintenance. This statement reflects the fact that costs, not expenditures, are at issue.**

The Provincial acceptance of normalized maintenance costs as proper for consideration by the Commission was related to the last sentence of the above statement. Costs, (or economic costs) were defined by the Provinces as:

---

*The Commission did not consider the Herchemer subdivision to be a grain dependent line for reasons set forth in Report, Volume I, p. 107.

** Exhibit AMS-17, p. 2.

a consumption of resources as contrasted with expenditures which reflected dollars spent.*

All of the parties agreed that costs were to be measured -- not actual expenditures. Clearly, in 1974 there was a greater consumption of resources on the grain dependent lines than was reflected in the actual maintenance dollars expended on those lines. Even if an average of the past five years was utilized, the actual expenditures would not reflect a "normal" level.

The Commission accepted the concept of normalized maintenance being a true "cost" for the year 1974 calculations and included the appropriate level of expense for this category in its cost calculations. For ease of determining the amount of maintenance shortfall included in the total variable costs it is shown as a distinct category in Volume I.**

Normalized Capital

Even if the actual capital expenditures on a line are equal to the depreciation charged against it, a capital shortfall will occur as a result of inflation:

Q. (Mr. Rothstein): But there is no doubt the shortfall arises as a result of inflation?

Mr. Romoff: That is correct. It is a deficiency

*Transcript, Vol. 30, p. 5856.

**Commission on the Costs of Transporting Grain by Rail; Volume I, Table 8, p. 200.

between capital needs and accrued depreciation in certain classes of assets.

Q. As a result of inflation?

Mr. Romoff: That is correct, sir.*

CP Rail calculated the annual capital expenditure, in 1974 dollars, required to maintain a typical (or average) mile of prairie branch line track at a constant, minimum operating standard (i.e., normalized capital expenditure). This was then compared to the actual road property depreciation expense charged to the grain dependent lines in 1974 to estimate the capital shortfall (i.e., the difference between the normalized capital expenditure and the recorded depreciation).

Canadian National treated normalized capital in a similar manner. However, for their initial submission, they performed the calculations for the grain dependent lines in conjunction with all other railway property. That is, rather than isolating the road property of grain dependent lines Canadian National aggregated all of its property into a group and calculated the effect of inflation on the entire amount of assets. This cost category was subsequently called the "Inflation Adjustment".** In their rebuttal submission,

---

*Transcript, Vol. 23, p. 4356.

**Exhibit CP-4, pp. 20 to 27 and Exhibit CN-2, p. 38.

Canadian National separated the capital shortfall portion relating to the road property of grain dependent branch lines* to provide a category comparable to that of CP Rail.

Therefore, while the reporting of the capital shortfall differed between the two railways, the methodology and concept were identical and, consequently comparable:

> The Commissioner: You (CP) put the solely related (grain dependent) lines on a current value basis for depreciation in the roadway adjustment?
>
> Mr. Saunders: Right.
>
> The Commissioner: And CN did not do that, I think, until we got to the inflation adjustment?
>
> Mr. Saunders: That is what happened.**

Cost items included in the normalized capital category are those items which are normally capitalized or depreciated over the life of the particular asset. However, the railway companies, in their computations treated the capital shortfall as an expense item and thus attributed the entire amount to the costs of transporting statutory grain in year 1974. The Commission agreed with the concept of including the capital shortfall as a proper item in the cost calculations but did not agree with the railway method of including these costs. As stated in Volume I of the Report:

---

*Exhibit CN-14, Table A-4, p. 8.

**Transcript, Vol. 1, p. 151.

> We developed the additional capital cost (i.e., depreciation and capital funds cost) that would have resulted from including the difference between the 1974 normalized capital expenditure and the actual expenditure made on the lines in 1974 in the gross and net asset base of the grain dependent lines. *

Level of Normalized Capital and Maintenance Costs

As one might expect, the engineering estimates submitted by the railway companies for their normalized capital and maintenance dollars, came under a great deal of indepth examination by many parties during the public hearings. The Provinces, in particular, were very concerned that the numbers put forward were intended to "build a Cadillac rather than the required Volkswagon" for light density grain operations. Table VI displays the evidence put before the Commission regarding studies undertaken in the United States and in Canada which confirmed that the estimates put forward by the railways were not excessive. In particular, the study undertaken by Loram International on behalf of the Prairie Provinces indicated that the estimates submitted by the railways were not out of line with those required for "absolute minimum maintenance" on selected Western branch lines.**

---

*Op. Cit., p. 127.

**_Transcript_, Vol. 20, pp. 3864 and 3865. The Loram Study was commissioned by the Prairies Provinces to develop cost data for use before this Commission and the Grain Handling and Transportation Commission.

Consequently, the Commission, in calculating the total costs for transporting grain by rail, has included an amount for normalized maintenance which is equal to the costs submitted by the two railway companies and has included an increment to the depreciation expense and return elements to cover the increase in the net and gross investment that would have resulted from a capital expenditure equal to the normalized capital level estimated by the railways.

Table VI

Comparison of Roadway Adjustment Costs

Study	Cost Per Mile	
	Rehabilitation	Normalized Maintenance and Capital
Canadian National *	$ 46,080	$ 3,716
CP Rail **	$ 24,631	$ 4,099
U.S. Study ***	N/A	$ 3,944
Loram International ****		
- to Min Standard 176,000 lbs.	$ 2,136	$ 3,688
- to Min Standard 220,000 lbs.	$ 28,567	$ 3,742
- to Min Standard 263,000 lbs.	$ 91,604	$ 3,530

* Exhibit CN-14, Table A-4, page 8. NOTE: These costs are based on 1974 price levels.

** Exhibit CP-5-R, pages CP-5-R-1 to CP-5-R-6. NOTE: These costs are based on 1974 price levels.

*** Transcript, Vol 17, pp. 3255-3273. NOTE: These numbers are from a study undertaken by R.L. Banks and Associates on behalf of the United States Government. The costs are based on a level of prices equal to the average price of years 1967-1971.

**** Transcript, Vol. 20, pp. 3864-3865. NOTE: These costs are based on 1975 price levels and exclude Federal sales tax, most camp operating costs and costs of transporting material to the work site.

REHABILITATION

The net result of the maintenance deferred on the grain dependent lines has been a deterioration of these lines to the point where the vast majority will require a large expenditure to bring them back to the desired standard. This one shot, "catch-up" expenditure has been termed by the railways, and referred to by all parties before this Commission, as being rehabilitation expense. Canadian National described this expense in their Submission to the Commission:

> It can be viewed as a restoration of the overall economic life which has been depleted as a consequence of the policy of minimizing grain losses*

Undertaking a rehabilitation program would restore the undermaintained lines to a minimum standard and would allow continued operation over them for a period of time. However, unless a normal maintenance and capital replacement program was instituted, the lines would once again slowly deteriorate until a point was reached where another large expenditure would be required to allow the lines to continue in safe operating condition.

The initial submissions of both railway companies included in the total cost calculations on amount for a

---

*Exhibit CN-2, p. 35.

rehabilitation or "catch-up" program to be initiated in 1974. The total cost of the rehabilitation program was amortized over ten years "on the assumption that a rehabilitation program would require 10 years for completion."* Neither railway declared that they would actually undertake such a program, nor would they indicate who should. They simply indicated that rehabilitation must be undertaken to allow an ongoing grain transportation system to develop and somebody must spend the required dollars. Table VI (page 92) displays the Railway and Loram International estimates of the per mile expenditure required to rehabilitate the dependent lines.

The Provinces took strong exception to including these costs in the 1974 costs of transporting grain by rail. Their position was that rehabilitation costs were a result of past railway management behavior, did not occur in 1974 and would not be spent by the railways in 1974 or, for that matter, at any time in the future.

During the initial hearings a great deal of discussion surrounded the inclusion or exclusion of the rehabilitation costs submitted by the railways for the grain dependent lines. However, in the rebuttal submissions of both railways, rehabilitation costs were shown as a separate cost item and were excluded

---

*Exhibit CN-14, p. 62.

from the total railway cost calculations. Speaking for the railways, Mr. Saunders explained this change:

> ...but for purposes of the cost study I felt that it was preferable to exclude these rehabilitation costs from the ongoing costs and to make that distinction in the revenue needs of the carriers. This was brought about as a result of extended discussions in Winnipeg and since the beginning of this hearing my views have been confirmed.*

Consequently, all parties and the Commission excluded rehabilitation costs from their 1974 estimates of the costs of transporting grain by rail.

---

*Transcript, Vol. 25, p. 4958.

CHAPTER IV

OTHER ISSUES RELATED TO THE DEVELOPMENT OF VARIABLE COSTS

This chapter presents a more detailed statement of the basis for the Commission's findings on other issues related to the development of the variable costs of transporting statutory grain by rail. Specifically, this chapter discusses communications and general expenses, traffic expenses, insurance costs and switching costs. The treatment to be afforded each of these in the determination of total variable costs was contested to some degree before this Commission.

COMMUNICATIONS AND GENERAL EXPENSES

Throughout the hearings and Technical Committee meetings a certain amount of discussion arose as to the "variability" of some expenses. When variability is discussed in this manner the analyst is saying: 'what part of the expense being measured is variable with the independent variable being tested?' That is: 'what part of this expense is variable with traffic as opposed to being a constant cost?' During the course of the hearings the Provinces questioned the railways at some length as to their assignment of 100 percent variability to Communications and General Expenses.

For purposes of developing costs for this Commission, CP Rail assigned, by direct analysis, 100 percent variability

to both communications expenses and general expenses. This assignment is different from that prescribed by the CTC in Order No. R-6313 * and from that used by CP Rail in all subsidy claims. The Provinces' position was that the variability prescribed by the CTC, namely 70 percent for Communications Expense (for CN and CP) and 60 percent** for General Expenses (for CP), should be used for this Commission's purposes. The Provinces stated that assigning 100 percent variability to these two accounts through direct analysis overstated the costs in the railway submissions. More generally, the Provinces took the position that:

> ...studies should be instituted by both railways to substantiate each use of this technique (direct analysis).***

This Commission shares the Provincial concern regarding improper use of the direct analysis method of assigning cost without strong substantiation. However, subsequent to the 1968-69 Cost Inquiry, CP Rail did undertake to resolve

---

*<u>Reasons for Order No. R-6313</u>, pp. 372-374.

**At the 1968-69 Cost Inquiry, Canadian National calculated General Expenses by regression analysis whereas CP Rail relied on results of a U.S. rail study to assign the variability to this account. The Commission consequently ruled that CP Rail could only assign a 60 percent variability function to General Expenses since they termed CP Rail's assignment "arbitrary". The Commission approved Canadian National's regression technique and did not assign a specific variability to Canadian National.

***Exhibit AMS-17, p. 62.

the question of the variability of Communications and General Expenses. Specifically, they conducted regression analyses of these expenses for 72 Class I U.S. railways for years 1969 and 1973 to determine their variability. The results of these studies are shown in Table VII.

Table VII

Regression Analysis of Communications and General Expenses
Results of CP Rail Studies 72 Class I U.S. Railways

	General		Rail Communications	
	1969	1973	1969	1973
R^2	.98	.92	.95	.91
T Value	65	28	37	26
F Value	4254	831	1423	677
Variability	101%	98%	95%	111%

Source: Exhibit CP-4, p. CP-4-7.

On this basis CP Rail concluded that both expenses were 100 percent variable and therefore through the direct analysis costing technique, assigned that percentage to each.

The Commission, in analyzing the 1973 CP Rail study, concluded that the results could have been unduly influenced by including a great many smaller railways in the sample of

72 U.S. railways. In an attempt to remove this bias the Commission chose the largest 14 U.S. rail carriers and, using 1973 data, undertook a similar test for variability to determine if the results were consistent with those of CP Rail. The results of the Commission's analysis are contained in Table VIII and fully support the CP Rail position.

Table VIII

Results of Commission Studies of 14 Largest Class I U.S. Railways

	General 1973	Rail Communications 1973
R^2	.91	.94
T Value	7.79	9.27
F Value	60.61	85.90
Variability	113 %	114 %

Another test, specifically related to General Expenses, that can be used to determine if CP Rail's assignment of 100% variability is reasonable, is to measure the average variability of this account as determined by Canadian National's regression analysis. The results of Canadian National's testing indicated that this expense is more than 100 percent variable with the independent variable tested, namely labour expense dollars.

Thus, the Commission's analysis, CP Rail's study and Canadian National's regression analysis all support the contention that Communications and General expenses are 100 percent variable with the labour expense dollars. The Commission used CP Rail's costs, as submitted, for these two expenses.

In the development of its costs for this Commission, Canadian National assigned a variability factor of 100 percent for General Expenses and 70 percent for Communications Expense. As indicated, Canadian National used the regression analysis technique which was accepted by the Canadian Transport Commission at the 1968-69 Cost Inquiry,* for calculating the variability of General Expenses. The result of the CN regression computations showed that General Expenses were 100 percent variable with the independent variable. All parties at the hearing accepted the assignment by CN of this variability factor for General Expenses, and the Commission used the costs for this expense as submitted by CN.

The assignment, by Canadian National, of 70 percent variability to Communications Expense was an arbitrary application by CN and merely followed the direction provided by the CTC in Order R-6313. Canadian National did

---

*Reasons for Order No. R-6313, pp. 372-373.

not undertake any studies examining the variability of this expense as CP Rail had done and thus could not substantiate any variability factor other than 70 percent. The assignment of this variability again was unchallenged by the other parties at the Inquiry. However, the Commission, in accepting CP Rail's costs and the validity of its special study, was also accepting the concept that Rail Communications Expenses, for all large railways were 100 percent variable. Consequently, the Commission recalculated the Communications Expense for Canadian National using 100 percent variability.

An addendum note should be added to this explanation. A source of confusion which can arise when discussing variability results from the difference between variability with the independent expense variable and variability with traffic. In the case of the above two expense items, the variability factors were discussed in terms of the independent expense variable i.e., labour expense dollars. However, the use of the 100 percent variability factor with labour expenses results in a variability of 85.6 percent* with traffic. This, of course, is because of the relationship between labour expenses and traffic volume.

---

*Exhibit CP-4, p. 7.

TRAFFIC EXPENSES

The Costing Manuals of the two railway companies generally reflect the CTC requirements contained in Reasons for Order No. R-6313 which states at page 372:

> ...we have decided that traffic expense should be excluded from the costing of grain traffic unless the railway can demonstrate that the grain traffic in question actually involves functions covered by traffic expense.

In describing the treatment of Traffic (Sales) Expenses, Canadian National's Costing Manual at page 6.410.03 states that the total variable cost of freight sales expense is calculated:

> for each of the commodity groups to yield a cost per net ton mile by commodity, excluding grain.

Similarly at page 9.070.1, CP Rail's Costing Manual reads:

> Freight revenue is expressed as a value per thousand net ton-miles for each of the following commodity groups:
>
> ...Agriculture products excluding grain and grain products

The Provinces of Alberta, Manitoba and Saskatchewan followed the costing manuals and excluded traffic costs from their cost submissions, as did Canadian National. CP Rail, however, undertook a special study to specifically

identify the traffic costs which were attributable to grain.

Mr. Romoff described the methodology for the CP study as follows:

> Well, this was a survey carried out by our marketing and sales people of all their field offices and head office to determine the people who spent time on grain concerned matters, the amount of time spent by such people from which we calculated the appropriate costs for these people.*

Based on this special study, CP Rail included $129,420 for traffic expenses in their calculation of grain transportation costs. On the surface, one might tend to agree with Mr. Banks:

> It is hard to visualize a charge in excess of $8,000 being devoted to solicitation of this alleged deficit traffic. This is what is claimed as a component of the $129,000 in the office of the regional marketing or sales manager for the prairie region.**

Our detailed examination of the study carried out by CP Rail left no doubt that some traffic expenses incurred by CP Rail are properly associated with and attributable to the transportation of statutory grain. Table IX displays the details of the CP Rail special study and reveals that Labour expenses made up $91,346 (including a factor for

---

*<u>Transcript</u>, Vol. 6, p. 1053.

**<u>Transcript</u>, Vol. 17, p. 3372.

Table IX CP Rail Traffic Expense* Analysis		
Labour-Position	**Staff**	**Expense Incurred**
• The office of General Manager Market Development**	- Marketing Director, Grain - Coordinator of Planning Grain - Marketing Analyst	$ 39,429
• The office of General Manager Marketing and Sales (Prairie Region)	- General Manager - Assistant General Manager - Assistant Office Manager - Pricing Staff - Stenographic	26,677
• The office of General Manager Marketing and Sales (Pacific Region)	- Assistant General Manager - District Manager - Traffic Analyst	8,004
• The office of General Manager Pricing Economics	- Pric. Director, Govt. Liaison - Senior Pricing Analyst - Secretary	8,475
Vacation & Holidays Factor		8,761
Material and Other Charges		38,074
	TOTAL TRAFFIC EXPENSE	$129,420

*Traffic Expense is described in the Uniform Classification of Accounts as "the expenses incurred for advertising, soliciting, and securing traffic for the carrier's lines and for preparing and distributing tariffs governing such traffic."

**These figures are not individual salaries but represent the total for each specified office, of the percentage of the salaries of all individuals related to grain traffic "sales."

vacations and holidays) or 70 percent of the $129,420 attributed to the grain traffic.

> To this (labour expense) was added the related material and other charges estimated on the basis of the ratio of the freight material and other expenses to freight labour in these accounts.*

For the purposes of this Commission's findings, we have determined the traffic expenses submitted by CP Rail as being properly included in the costs of transporting grain by rail.

Absent a special study by CN, we could not properly or accurately determine the amount of traffic expenses incurred by Canadian National Railways that was attributable to grain transportation. Thus, traffic expenses are not included in the Commission's cost findings for Canadian National. The Commission recommends that Canadian National undertake the appropriate studies to specifically identify those traffic expenses (if any) which are attributable to grain transportation. Such costs, similarly verified, would then be properly attributable to the total cost of transporting grain by rail.

---

*Exhibit CP-4, p. 8.

INSURANCE COSTS

The original Provincial Submission contended that Canadian National data led to the conclusion that CN insurance costs were excessive because management had made a decision to insure themselves at a higher level than did CP Rail management. The Provinces agreed that Canadian National's management had the right to decide the appropriate level of insurance but contended that grain should not be charged for excessive insurance. They based their assertion on the fact that when the expense to revenue ratios were compared between the two railways, Canadian National showed a significantly higher ratio than did CP Rail. The Provinces in their cost calculations,* consequently factored down by 25 percent the insurance costs submitted by Canadian National.

In their rebuttal submission Canadian National presented the results of a computation showing the total dollars paid for both insurance premiums and loss and damage claims for the years 1971-74. The ratio of revenue to expenses was obtained for each of the four years. These ratios were not significantly different** from the corresponding

*Exhibit AMS-1, p. AMS-N5.3.

**Exhibit CN-14, pp. 37-39.

ratios of CP Rail. Table X is reconstructed from CN Working Papers and illustrates that the combined insurance and loss and damage expenses of the two railways are consistent.

It is clear that the reason for the apparent discrepancy identified by the Provinces was a result of how each railway recorded its insurance premiums and its loss and damages. A discussion that the Commissioner had with Mr. Alalouf of CN adequately portrays the difference:

> The Commissioner: As I looked at AMS N5.3, if you take all of the losses shown on AMS N5.3 and all the insurance expenses shown and get the total of both and take it as a percentage of revenue, the figures for the two railways come very close together, 2.47 and 2.43 I believe. What creates the difference is the exclusion of loss and damage from their calculation. Have you made that type of a test, Mr. Alalouf?
>
> Mr. Alalouf: Yes, we have. We have done the calculation including loss and damage.
>
> The Commissioner: Am I correct that the dollars expended for self-insurance and insurance using only their numbers per dollar of revenue is approximately the same when you include loss and damage?
>
> Mr. Alalouf: Yes.*

Having identified the reason behind the apparent inconsistency between the two railways in this area, and having subsequently reconciled the difference so that consistency

---

*<u>Transcript</u>, Vol. 22, p. 4243.

Table X
Canadian Railways Comparative Insurance Expenses
CN and CP Rail* ($000's)

	1971		1972		1973		1974		Total	
	CN	CP	CN	CP	CN	CP	CN	CP	CN	CP
Total Operating Expenses Accounts 274, 332, 415, 416, 418, 419, 420. (Loss and Damages)	$ 8,781	$13,066	$10,440	$13,794	$11,945	$16,584	$17,425	$21,266	$48,591	$64,710
Total Insurance Premium Accounts 275, 333, 357, 414, 455.	11,555	572	15,012	500	16,476	857	16,841	1,499	59,884	3,428
Total Other Rail, Ties, Ballast, Etc. related to Accidents	882	1,887	890	1,904	1,090	2,332	1,441	3,083	4,303	9,206
TOTAL	21,218	15,525	26,342	16,198	29,511	19,773	35,707	25,848	112,778	77,344
Rev/Expense Ratio	2.298%	2.352%	2.588%	2.280%	2.637%	2.558%	2.576%	2.763%	2.537%	2.511%

*Source: CN Working Paper, May 21/76.

is shown to exist, the Commission rejected the Provincial arguments and used the insurance costs as submitted by Canadian National and CP Rail.

SWITCHING COSTS

The main concern in regard to yard switching costs expressed by the parties during the hearing process centered on the issue of the size of grain car cuts versus all other traffic and the subsequent reflection of any difference in the output units used to compute the costs attributable to grain transportation.

Canadian National undertook an in depth study of its five largest terminals. These terminals (Winnipeg, Edmonton, Saskatoon, Vancouver and Thunder Bay), accounted for 70 percent of the yard engine hours incurred at all terminals in the West. In addition, ten smaller terminals* were included in the Study. For these terminals, Regina was used as a proxy with respect to cars per cut and times per cut. By this method Regina was explicitly studied and the results obtained were used to compute yard engine hours in each of the ten smaller terminals. Canadian National stated that:

---

*The ten smaller terminals were Brandon, Churchill, Dauphin, Melville, Prince Albert, Regina, Calgary, Kamloops, Prince Rupert and Victoria.

> The purpose of these (switching) studies was to determine the portion of the total annual yard switching time attributable to statutory grain traffic and to express this time in terms of minutes per loaded and empty grain car at the originating and terminating points. In addition an assessment of time required to handle cars passing through terminals was developed.*

> For the five larger terminals:

> ...data for determining differences (grain versus non-grain) in cut size and for qualifying the original apportionment of yard engine time ... was assembled and analyzed at the individual terminal offices with the assistance of yard personnel.**

The results of this study (reproduced as Schedule X, Page 1) showed that costs of grain car switching were, on the average, seven percent lower than for all other commodities. Canadian National clearly differentiated between switching times for grain traffic and all other traffic as indicated from the questioning of Mr. Pringle by Mr. McLeod:

> Q. (Page 4): Here, looking at the two right-hand columns taking Churchill grain is 3.2 minutes, non-grain 8.7, Douphin grain 34.8 non-grain, 61.6 or almost double, Saskatoon grain 17.3 and non-grain 38.8 down the list. A very substantial difference in average switching minutes and in each case I think without exception grain being noticeably lower than non-grain traffic. ... Having in mind the very significant differences ... would you not agree that the use of system averages for traffic as suggested in this reference on page 178 would substantially overstate the switching costs for grain?

---

*Exhibit CN-2, p. 98.

**Exhibit CN-2, p. 100.

> Mr. Pringle: ...our studies are no longer based on a classification time for the cars in the terminal.
>
> Q: So it is the actual figures for grain that are used?
>
> A: That is right.*

The Provinces accepted the results of the special switching study undertaken by Canadian National for its cost development:

> By contrast with CPR the CNR yard studies did give explicit recognition to the number of cars per cut for grain, to the number of cars per cut for other traffic, and to the resulting differences in switching-minutes per car.**

CP Rail was not as explicit in its measurement of switching times expressly related to grain traffic. For its initial submission CP used the results from a switching study undertaken, not specifically for this Commission but, as part of their Research & Development program. During the Winnipeg proceedings a great amount of criticism was directed towards CP's methodology for determination of its switching costs. CP, however, maintained that the times used for grain did in fact, reflect the particular handling characteristics associated with switching of grain cars. For the rebuttal hearings, CP compiled additional switching information which,

---

*<u>Transcript</u>, Vol. 15, pp. 2896-2897.

**Exhibit AMS-2, p. 28.

they claimed, substantiated their original cost estimates for grain car switching:

> Mr. Kelsall: ...Now, for purposes of the Commission we have since Winnipeg made an analysis to assist the Commissioner on the subject of cut size and we have been very busy developing this and we have developed it for the basis of through grain traffic...*
> ...
>
> The Commissioner: ...Do I understand correctly, Mr. Kelsall, that this additional information you are about to provide is not a substitute for the switching studies and the switching costs that you have calculated in your intial and rebuttal statement but, rather, is a separate study dealing only with cut size?
>
> Mr. Kelsall: That is right, sir. There are no changes in the unit switching times. This is simply additional information which we thought would be of use to you and to the other parties as simply additional facts on the way in which we carry out our operations.**

Mr. Kelsall then read into the record the switching cut sizes which CP arrived at through their latest study. Cut size is defined quite simply as the number of cars which are switched at one time. The time per car is less with multiple car cuts and therefore cost savings accrue when several cars can be switched with a less than proportionate increase in the amount of resources expended over that which would be utilized if only one or two cars were in each cut.

---

*<u>Transcript</u>, Vol. 23, p. 4382.

**Ibid., Vol. 23, p. 4392.

> It should be noted that in a typical switching operation, the largest amount of time is consumed in the primary move (travelling from point A to B to make contact with or break away from a car or train). If the primary move was made for one car then that car assumes the costs, but if the move was made for five cars, each car assumed a portion of the time taken for that move. But now instead of making the primary move and walking one car length to obtain the cut, we have to add to that move additional time to walk five car lengths and obtain the cut. At the other end of the move, we would have to travel an additional four car lengths in order to clear the switch and add to this extra time for acceleration and deceleration (account of added weight), and our time would increase proportionately. Thus, the total time per car for five cars is not one-fifth of that for one car.*

The CP information tended to bear out its previous claim that its average times did reflect grain switching generally in Western Canada but perhaps not at specific terminals. This is shown in Schedule X (page 2) which is, in part, a reproduction of CP Exhibit CP-48.

The methodology employed by CP Rail to obtain switching times and cut sizes differed for the various yards and different types of switching required. For flat yard switching, there were some terminals where grain switching was recognized as being unique and was isolated for measurement purposes. In other yards, grain was assigned the average or same time as any other car. For hump yard terminals, grain was assigned the same minutes per car as any other

---

*Exhibit CN-2, pp. 112 and 113.

car since, when grain is humped, it goes over the hump one car at a time and not in cuts.

While the Commission has accepted CP switching costs, and believes them to be representative for grain operations, it is nevertheless true that the results upon which they rely are based on the "judgement" of their operating personnel or as is stated by the Provinces very clearly,

> The overwhelming majority of the switching "studies" undertaken at yards by CPR personnel are in fact not switching studies, but rather judgments made by yardmasters and other personnel that prior studies remain accurate for this instant analysis.*

Engineering or "on-the-ground" studies were not undertaken and, as accurate as the "judgements" may be, they will always be open to suspiscion and criticism. The Commission suggests to both railways that they undertake, as part of their continuing R & D work, the appropriate documented studies based upon on-the-ground measurements.

---

*Exhibit AMS-17, p. 63, AMS-R-606.

Chapter V

CONSTANT COST ISSUES

The two basic separations inherent in the total system costs of a railway operation are variable costs and constant costs. The definition of variable costs adopted by the C.T.C., was also adopted by this Commission and the Parties appearing before it for purposes of this Inquiry. That definition is:

> Variable cost may be defined as the long-run marginal cost of output, being the cost of producing a permanent and quantitatively small change in the traffic flow of output, when all resource cost inputs are optimally adjusted to change.*

The principal distinctive characteristic of variable costs is that, because they vary with levels of output, they can be directly or indirectly associated with particular output units which, in turn, can be associated with particular commodities carried and/or services performed. Constant costs, on the other hand, are residual in nature. They are the difference between the total system costs and the total system variable costs. The principal distinctive characteristic of constant costs is that they cannot be directly or indirectly associated with particular output units and, hence, cannot be associated with particular commodities and/or services performed.

---

*Reasons for Order No. R-6313 Concerning Costs Regulations, p. 337.

Constant costs may be the least understood and most misinterpreted aspect of rail costing. One source of this misunderstanding and misinterpretation is the notion that constant costs are threshold costs which occur when there is zero output and remain the same through all ranges of output.

The true nature of the constant cost function is most aptly described as follows:

> Constant costs are not defined as those at zero output, but rather those which remain at any given output level after the variable unit costs have been applied to all the output. They are not literally constant, or unvarying, but may fluctuate with the output level if curvature exists. <u>Their name would more accurately be 'costs which cannot be associated with output units at this level</u>.'* (emphasis supplied)

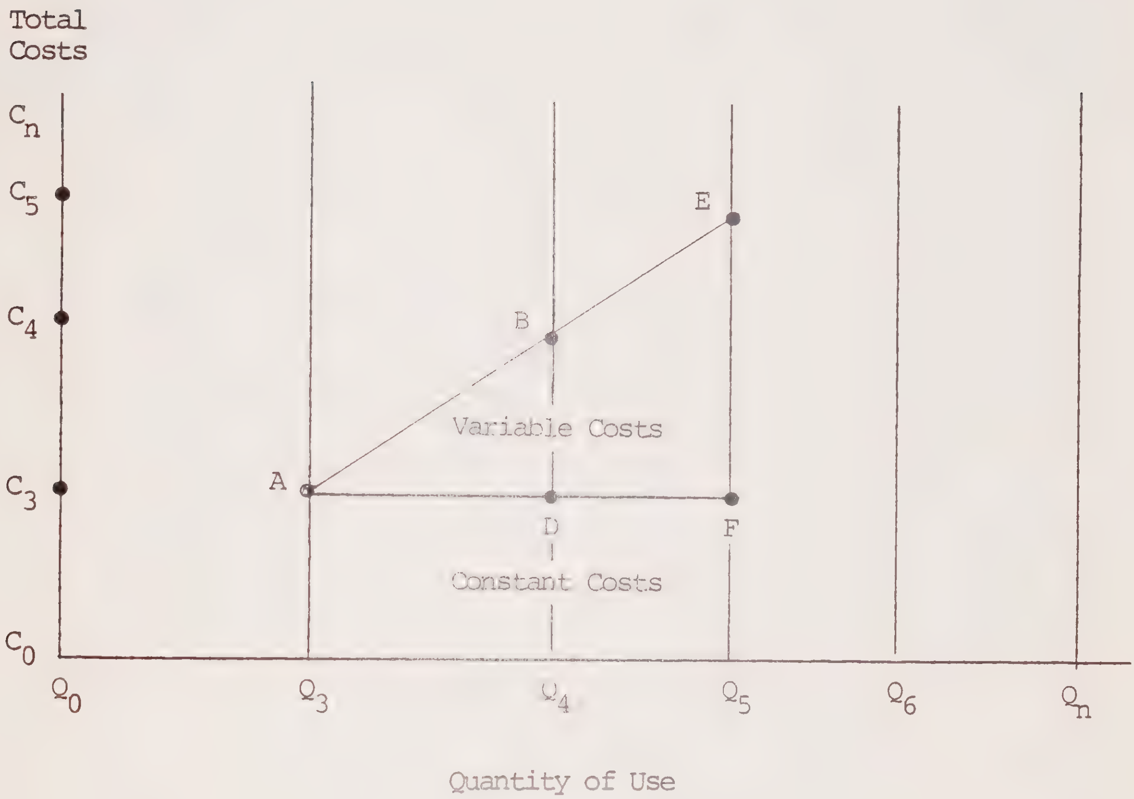
Figure IX (following page) shows these two cost functions in their most simplistic sense. In this schematic, a total system output level of Q_5 would produce a total system cost equal to C_5, a calculated variable cost equal to C_5 minus C_3 or the amount represented by EF and a constant cost equal to C_3 (also FQ_5.

---

*Exhibit CN-2, p. 20. See also <u>Transcript</u>, Volume 2 pp. 218-220.

FIGURE IX

Schematic Diagram of Railway Cost Functions



This simplistic notion of the separation of railway costs between variable and constant becomes clouded when consideration is given to system size-related costs. It is well established and accepted that, though certain cost elements are constant in nature, the magnitude of these costs varies with the size of the railway. For example, the salary paid to the President of a small,

short-line regional railway undoubtedly is considerably less than that paid to the President of a large transcontinental railway. Similarly, a substantial portion of the maintenance expenses and capital costs associated with the railway roadbed and track structure is associated with the miles of track (i.e., size) rather than the use made of the track (i.e., quantity of use).

Because of this, a portion of the railways' costs are size-related and will remain constant so long as the railway remains in a certain size category. With reference to Figure IX, we could group railways into three size categories, namely small railways with output ranges between Q_0 and Q_3, medium size railways with output ranges between Q_3 and Q_5 and large railways with output ranges between Q_5 and Q_n.

Each of these three size categories would have their own distinct total, variable, and constant costs functions. This is because the total cost function, over all ranges of output, is probably curvilinear.

> A more realistic view of the archetypical cost function is that it is curvilinear, may or may not have an actual threshold cost at zero output, rises to the right but at varying rates, usually less steep at some point than it was initially (concave downward), but ultimately

becoming increasingly steeper as it curves upward...*

The information presented by the parties to the Inquiry leads us to conclude that, within the relevant range of the present system output, the linear form of the cost function is a reasonable approximation of the true cost function. Also, there is no evidence to suggest that the exclusion of the grain traffic would cause the system output to fall below the relevant range of output of the present system including the grain traffic. The cost experts who appeared before the Commission predicated their conclusions on the fact that the exclusion of the grain traffic would not change the relevant range (i.e., in the Figure IX example outside the range Q_3 through Q_5). Thus, for example, if the grain traffic consumes a quantity of use equal to Q_5 minus Q_4, then, under normal railway costing procedures, the total variable cost attributable to this traffic would be C_5 minus C_4** and the system constant costs would remain unchanged at C_3.

---

*Exhibit CN-2, p. 18. See also <u>Royal Commission on Transportation</u>, Volume III, p. 295.

**Determination of the total variable cost attributable to the grain traffic in this manner is consistent with the accepted definition of variable costs even though the inclusion or exclusion of this volume of traffic cannot be considered as a quantitatively small change in the traffic flow of output. This is because the restriction to quantitatively small in the definition is removed when the cost function is linear, or nearly so. (Exhibit AMS-1, p. 7 and AMS-2, p. 7.)

Despite the general agreement as to the nature of constant costs, this Commission was faced with two issues. The first related to the categorization (Variable or Constant) of the operating and capital costs incurred on the grain dependent lines. The second issue was concerned with whether or not some portion of the system constant costs should be allocated to, and considered a part of, the total costs of transporting statutory grain by rail.

Cost Classification - Grain Dependent Lines

For reasons set forth in Volume I (pages 106-109), this Commission has adopted the concept that the existance of the grain gathering lines is dependent upon the grain traffic. Thus, it clearly follows that the size-related costs of those lines are attributable to and caused by the grain traffic. While the attribution and assignment of these costs to the grain traffic is accepted by both the railways and the Provinces, there is an issue as to whether the costs should be treated as variable costs or as constant costs.* Though the total dollars of cost charged to grain under either con-concept is the same,** the Commission believes this conceptual

---

*The railways treat these costs as variable costs and the Provinces treat them as relevant constant costs.

**Any difference in dollars of cost is attributable to different definitions of the grain gathering system rather than determination of the cost dollars.

issue could be of sufficient import to its findings to warrant discussion and resolution.

The Provinces labeled the costs attributable to the existence of the grain dependent branch lines relevant constant costs while the railways called them variable. However, both parties treated them essentially the same in developing the total costs attributable to statutory grain. The Alberta Wheat Pool, Saskatchewan Wheat Pool and Manitoba Pool Elevator companies, on the other hand, argued that the line related costs should not be included in the total costs and:

> recommend that concepts of solely related and segregations of constant cost to branch lines be terminated, that grain should be treated as a component of one large railway.*

If the line related costs of the prairie branch lines are variable then they are relevant costs for this Commission to consider. If, however, these particular costs are proven to be constant costs, then they should be treated the same as all other system constant costs. To determine if these can logically be considered as variable costs, the analyst must go back to the nature of variable and constant costs.

---

*Exhibit WP-3, p. 9.

As indicated, normal railroad costing procedures would produce variable costs equal to C_5 minus C_4 in Figure IX and the system constant costs would remain unchanged. However, the existence of the grain gathering lines creates a special set of circumstances. Normally, an increase or decrease in the traffic flow or output within the relevant output range will not cause a change in the system roadway and track structure and cannot be associated with the existence or non-existence of particular branch lines or subdivisions. For this reason, the railways treat the portion of roadway maintenance, depreciation, and cost of money associated with track-miles and gradient as part of the system constant costs. Thus, the line-related roadway and track structure costs* for the grain dependent lines normally are included in the system constant costs.

The proposition that the size-related costs of the grain gathering lines are constant is bottomed on the finding that these lines are outside the relevant range of output. At page 13 of Exhibit AMS-1 it is stated:

> By contrast, the irrelevant range of output shown in Exhibit AMS-N2.2 reflects the curvilinear nature of the lower range of output, which the linear methods fail to capture. This irrelevant range of output is, in the present context, typified by the

---

*In addition, these costs include dollars related to stations, signals, and communications.

> substantially grain-related subdivisions, <u>all</u> the constant costs of which have, by the Alberta-Manitoba-Saskatchewan estimates, been assigned to the statutory grain traffic.*

The Commission has difficulty in accepting this contention particularly since the Provinces agree that the elimination of the grain traffic, and hence, the grain gathering system, would not cause the system output to fall below the relevant range of output.** Indeed, the only support the Commission can find for considering these costs to be constant is that as a matter of routine cost calculation the railways treat them as constant costs.

The support for including these costs as variable costs is based on the contention that there are two categories of variable costs, namely those that can be associated with small increments of traffic*** and those that can be associated with a total traffic or service.**** The Commissioner discussed this with the railway witness in the following exchange:

---

*Exhibit AMS-N2.2 is reproduced, in this Appendix, as Figure VII.

**Exhibit AMS-17, p. 40.

***There is complete agreement that costs of this type incurred on the grain gathering lines are assignable to the variable cost component.

****Exhibit R-1, p. 47.

THE COMMISSIONER: All right. So the sum of those two is the total variable?

MR. SAUNDERS: Yes.

THE COMMISSIONER: And the 106 million figure is the variable cost which you have calculated in accordance with the definition of variable cost found in the cost order, is that correct?

MR. SAUNDERS: That is right.

THE COMMISSIONER: And the solely-related variable costs you effectively have defined as those costs which are not variable with small increments of traffic but are variable with a totality of a particular traffic or service. Is that correct? I mean is that a fair paraphrase of what you mean?

MR. SAUNDERS: Yes, that is right.

THE COMMISSIONER: In that sense are you treating the solely-related costs similar to the way one would deal with passenger costs in that you have some costs which are variable with additional passengers and other costs which are variable with the entire service?

MR. SAUNDERS: Service as a whole.

THE COMMISSIONER: So if the service disappeared all of the costs would disappear?

MR. SAUNDERS: That is right.*

Additional support for the concept of variability of the grain gathering line related costs is found in the following statement of Dr. Borts.

> Well, we did not do it for two reasons. I have already mentioned lack of time but I should also mention that <u>the philosophical basis of our treatment of branch line costs used to treat them as 100 percent variable with the grain traffic</u> so that we felt it was very necessary to extract them.** (emphasis supplied)

---

*<u>Transcript</u>, Vol. 1, page 117.

**<u>Transcript</u>, Vol. 7, page 1261.

The determination of whether these costs are variable or constant must be made in light of the definition of variable cost adopted for this study with the quantitatively small constraint removed. Thus, the definition now reads as follows:

> Variable cost may be defined as the long-run marginal cost of output, being the cost of producing a permanent change in the traffic flow of output, when all resource cost inputs are optimally adjusted to change.

Accepting, as the Commission has, that the existence of the grain gathering lines is dependent upon the grain traffic, it clearly follows that the size-related costs of the grain gathering lines are variable under the above definition. This is because the size-related costs are resource cost inputs and, therefore, by definition, would be eliminated under the optimal adjustment constraint of the variable cost definition.

This conclusion is, in the Commission's opinion, consistent with the accepted definition of variable costs, notwithstanding the fact that in their routine costing practices, the railways treat these costs as constant. In arriving at this conclusion, the Commission is cognizant of the fact that this is a particular circumstance of variability that will only occur when the following conditions are present:

- the total quantum of system traffic will remain in the relevant range of output with or without the quantum of study traffic;

- the study traffic uses specific facilities or plant that can be identified and that exist solely because of the existence of the study traffic; and

- the methodology used to develop the costs associated with the specific facilities or plant recognizes size-related costs as a separate and distinct cost element.

In this regard, we note that the railways concede that there are other traffics or services that meet the above conditions. Thus, to the extent that size related costs for these traffics or services are included in the system constant costs, the total system constant cost derived under normal costing procedures is overstated and the variable cost of these traffics derived on the same basis would be correspondingly understated.

Having determined that the costs associated with the grain dependent lines can be termed variable with the study traffic, the Commission was faced with the problem of delineating the lines in Western Canada which were grain dependent.

The criteria employed by the railways to identify those Western branch lines which they termed solely related to the transportation of statutory grain is outlined in Exhibit R-1, pages R-1-40 and R-1-41, and Exhibit CN-2, pages CN-2-33 and CN-2-34. The universe from which the railways extracted the solely related lines was the total of subsidized branch lines in Western Canada.* Each of the lines selected by the railways had to meet all of the following criteria:

- A substantial proportion of the traffic originated or terminated on the line consisted of statutory grain.**
- the line was not required as a bridge for non-grain traffic.
- Non-grain traffic originated or terminated on the line would not provide economic justification for the continued operation of the line.
- Additional industry development was not planned for location on or near the line.

The Provinces, more as a result of a lack of data than a disagreement in procedure, identified what they termed as substantially related lines. Their identification was made on the basis of volume only.

---

*<u>Transcript</u>, Vol. 2, p. 245.

**For the lines CN identified as solely related, no line had less than 57 percent of its total originated and terminated tonnage consisting of statutory grain. For these solely related lines identified by CP Rail, no line had less than 60 percent statutory grain.

> These lines are defined as those subdivisions, whether or not subsidized, on which originated carloads of statutory grain equal or exceed 67 percent of total originated and terminated carloads.*

The Commission adopted the more stringent criteria employed by the railways for use in identifying the railway branch lines related to the transportation of grain traffic, with the exception that all lines in this category must have a total of at least 60 percent of all traffic, terminating or originating, consisting of statutory grain. This additional criteria reduced CN's total solely related mileage by 364 miles for a total mileage for Commission purposes of 3,355 miles. CP miles were unchanged at 3,772.

The lines identified as solely (or substantially as the Provinces have termed these lines) related to grain are detailed in the respective submissions of the railways and Provinces.** The lines which the Commission identified as being grain dependent are delineated in Appendix H, Volume I of this Commission's Report.

Allocation of System Constant Costs

Given that this Commission considered the line related costs of the grain dependent prairie branch lines as variable

---

*Exhibit AMS-2, p. 49.

**See Exhibits AMS-1, p. AMS-N7.1; AMS-2, p. AMS-P6.1; CP-4 Schedule 2; CN-2, Attachment XXII.

costs, it was still faced with the issue as to whether or not some portion of the system constant costs should be allocated to the statutory grain traffic.

Background

The testimony before this Commission revealed many areas of agreement as to the nature and role of system constant costs in the determination of the relevant costs of transporting grain by rail. The most significant areas of agreement are as follows:

- By definition, true system constant costs cannot be attributed to a particular traffic or service and, therefore, their apportionment or allocation on a statistical basis to a traffic or service is arbitrary.

- A railway must receive revenues equal to its total system costs (variable plus constant) if it is to be an ongoing, viable enterprise.

- The share of the total system constant cost borne by a traffic moving under market based rates (rates not subject to maximum rate regulation or statutory regulation), will be dictated by competition which determines the rate charged and hence the revenue received for transporting the commodity.

- The railway objective is to set market based rates at the level above variable costs which produces the maximum absolute contribution to the system constant costs (i.e., the rate level at which the absolute total net revenue will be the greatest).

- The rate level and total contribution to system constant costs of traffic moving on market based rates will not be affected by the contribution, or lack thereof, from regulated or statutory rate traffic.

- If the revenue received from statutory grain traffic is exactly equal to its variable costs, the railway will be indifferent to the traffic and the railway's system viability will not be affected.

- The statistical allocation of system constant costs is only an issue for traffic whose rates are not set on a market basis.

- A statistical allocation of system constant costs to statutory grain traffic is an attempt to estimate the revenue contribution this traffic would make if its rates were set on a market basis.

It is most significant that the MacPherson Commission faced an identical problem to that presented to this Commission viz: Should constant costs be included in the relevant total costs of handling grain by rail? Of equal significance is the fact that the reasons for including or excluding constant costs presented to the MacPherson Commission were virtually identical to those presented to this Commission.

There are two principal differences in circumstances which existed when the MacPherson Commission considered the subject and those which affect the present analysis. The first is that the MacPherson Commission did not consider the size-related grain gathering line costs to be variable as did this Commission; further, the MacPherson Commission anticipated and proposed a rationalization of the rail plant which would reduce the railways' total constant costs as that Commission defined them. This Commission is cognizant

of the work of the Hall Commission and anticipates that it will result in rationalization of the western branch line network. As most of this rationalization will occur on the grain gathering lines, any cost reduction resulting therefrom will impact principally on the line related variable costs.

The second difference is that the MacPherson Commission gave some consideration to its recommendations for meeting passenger service deficits in its treatment of the constant cost issue. While the railways also claimed passenger service deficits were incurred in 1974, this Commission does not find such deficits relevant to a determination of the amount of constant costs, if any, that should be allocated to grain traffic.

Order No. R-6313 and the Reasons for Order No. R-6313 (Pamphlet No. 15) make no reference to constant costs. Our review of the record of that Inquiry indicated that the appropriateness of including an allocated share of constant costs in the total costs attributed to a particular commodity was not addressed by the C.T.C.. Thus, the most recent background to the constant cost issue is found in the testimony and findings of the MacPherson Commission. A lengthy passage from that Commission's Report describes this background:

> Turning to the problem of apportioning constant cost to the carriage of export grain, we found that there were a number of different ways in

which the allocation could be made, and in fact no single consideration was found to be satisfactory. We could find little justification for the contention that, because grain constitutes a significant proportion of work done by the railways, it must automatically bear some fixed proration of constant costs. In making our own assessment of the proper assignment of these constant expenses we kept two considerations in mind. The first is that the traffic should not be a burden to other traffic, nor be unduly onerous to railways owners, by failing to bear any share of overheads. Further, the extent to which the grain traffic contributes to overhead will have a bearing on the total profitability of rail enterprise which in turn helps to determine the cost of borrowing in the money market.

The second consideration arose from the fact that in our opinion a rationalization of railway plant is required. To allow a full return on all plant might be construed as an admission that all of the railway plant in Western Canada is 'used and useful.' The recommendation respecting the payment on behalf of export grain is based on the decision that it is not. Such a full allowance would, therefore, discourage railways from abandoning redundant lines.

...

We, therefore, recommend that upon submission and approval of reports of the variable cost of moving grain and of the revenue therefrom for the previous year, the railways be granted annually a sum of money equal to the shortfall of revenues on variable expense plus $9 million in the case of Canadian Pacific Railways and $7.3 million in the case of Canadian National Railways. In any of the years where for one or both of the railways the revenues from the carriage of grain from Western Canada to export positions were greater than the variable costs, the railways would be granted the sum of $9 million in the case of Canadian Pacific and $7.3 million in the case of the Canadian National less the excess revenue over variable costs.

When the process of rationalizing plant by elimination of rail lines occasioning a system net loss has substantially progressed, or when it appears that there has been any other substantial change in the overhead costs of the railways, the constant costs of the railways should be re-

> evaluated. After these re-evaluations the remuneration paid on behalf of the movement of grain and grain products to export positions at statutory and related rates should be adapted to the changed situation.*

Expressing reservations with the findings of the MacPherson Commission, Commissioner A.R. Gobeil stated as follows:

> I cannot accept this finding (the constant cost allowance) for the following reasons:
>
> 1. By definition, constant costs are those which cannot be allocated to any specific segment of traffic or service.
>
> 2. Every expert who appeared before the Commission agreed that constant costs were distributed among the various traffic movements on the basis of what each particular traffic movement could bear. The majority, by its decision, has determined not what the grain traffic can bear but rather what, in the opinion of the Commission, the grain traffic should bear. In my opinion, the Commission has assumed the function of the ratemaking authority and has exceeded its function as set out in Term (b) of the Reference, namely to determine burden
>
> 3. I cannot accept the decision that finds that in the case of grain which has a shortfall of $6 million there should be added thereto a sum of 16.3 million, but that in the case of passenger services and light density lines, having a combined short-fall of $78 million or 12 times greater than grain, no allocation of constant cost should be made.**

---

*<u>Royal Commission on Transportation</u>, Volume 1, March 1961, pp. 29 and 30.

**Ibid., pp. 43 and 44.

Relevance of System Constant Costs

The railways are the major proponents of the proposition that a statistically allocated portion of system constant costs must be included in the total costs of transporting grain by rail. Part of their rationale for the inclusion of constant costs is found in the following statement in their Summary and Final Arguments:

> The Railways and the Provinces agree that, in the normal type of cost-finding procedure, constant costs need not be allocated to traffic. This is because the rate-maker inherently performs an allocation when he sets rates at differing levels above variable costs.
>
> In the present situation, we do not have 'normal' circumstances. The existence of the statutory rate system means there is presently no room for normal, market allocation.
>
> Yet the responsibility of this Commission is to consider the total costs incurred in handling statutory grain by rail. How is this to be done in the absence of a market mechanism for the allocation of the constant portion of costs?
>
> An allocation of constant costs must be based on statistical methods where there is no free market method.*

The railways also base their position on the proposition that since statutory grain is a substantial portion of the total system traffic, it must make a significant contribution to the recovery of the total system

---

*Summary and Final Argument of Canadian National and CP Rail to the Commission on the Costs of Transporting Grain by Rail, pp. 15 and 16.

constant cost burden in order that the financial viability and well-being of the railway system is preserved.

The railways' position required that the Commission evaluate and answer the issues raised by the following three questions:

- Is a portion of system constant costs, however allocated, properly part of the relevant total costs incurred in handling statutory grain by rail?
- Does the statistical allocation method produce a reliable estimate of the portion of the system constant costs that would be allocated to statutory grain if its revenues were based on market rates?
- Must a portion of system constant costs be included in the total costs incurred in handling statutory grain by rail to insure the ongoing viability of the railway system?

There is no doubt that system constant costs* are real costs to the railways and form a component of the railways' total system costs. There also is no doubt that total system revenues must be equal to or greater than total system costs if the railway system is to remain viable. However, the question to be answered by this Commission is whether

---

*System constant costs are defined here as those costs which are related to the system as a whole. They exclude costs which can be attributable to the carriage of all traffic of a particular commodity such as the line-related costs of the grain gathering branch line network.

statistically allocated constant costs are relevant to a determination of the total costs of transporting grain by rail.

The crux of the issue as to whether a statistical allocation of constant costs is relevant to a determination of the total cost of transporting statutory grain is found in the following two statements:

> This development of the concept of the long run variable cost means that the total pool of expenditures has now been divided into two general categories: fixed and variable. The costs which are variable are treated as directly assignable to particular traffic. What is left is by definition not variable with particular traffic. It may be thought of as a fixed total pile of dollars not chargeable on any specific or actual basis to particular traffic. Yet the natural tendency is to ask what are the full costs as well as what are the variable costs. Somehow there is often an expressed need to account for all of the money spent by the railroad. One is pressed to go beyond the simple statement that the cost of hauling commodity "X" from point "A" to point "B" is $300 per car plus a share of, for example, $200 million of fixed cost. <u>Yet from the standpoint of the cost analyst, this is as far as one may go with meaningful calculations. Any step taken beyond this point must be recognized as essentially arbitrary</u>.
>
> The foregoing stems directly from the essential definitions and <u>it must be thoroughly understood that any attempt to go beyond variable costs is necessarily the extension of the prorating concept rather than an actual 'cost'</u>.* (emphasis supplied)

---

*Exhibit AMS-4, excerpts from a statement entitled <u>For the Royal Commission on Transportation, The Problems of the Canadian Railways</u>; Volume II, "Costing Methods", W.B. Saunders & Company.

> These (cost-finding) computations, then, consist of two processes. One is (the determination of variable cost) which is the ascertainment of facts; the other is apportionment (of fixed cost) which is the determination of policy. The former concerns itself with what is; the latter with what should be. One process consists of untwisting the intertwined but distinct strands of particular causation; the other of splitting the homogeneous fibers of a single cost...(Variable expense measurement) aims to find what each service costs; (constant cost) apportionment aims to determine what each service ought to pay.
>
> Combining the two figures seems like adding quarts to feet. The desirable course would seem to be to resolve the total 'cost' into its constituent elements, one marked 'Matter of fact--...(Marginal) Cost of Service' and the other labeled 'Matter of Opinion--Mathematical Photograph of Witness's Sense of Justice..."*

The economic experts who testified before this Commission agreed that in the contemporary period, the total system constant costs would be the same with or without the statutory grain traffic.

Q. MR. FORAN: I see. Mr. Romoff, could I refer you please to Schedule 5 in CP-4?

A. MR. ROMOFF: Yes sir.

Q. Development of 1974 constant costs. After deducting the amount which you have calculated for solely-related costs of $24,577,727 you have a balance of total constant costs of $201,481,906. Is that correct?

---

* Exhibit AMS-1, pp. 8 and 9, quoting: Allen S. Olmstead, II, "Do Cost of Transportation Exhibits in Railroad Rate Cases Show Cost?" Annals of the American Academy of Political and Social Science, Publication No. 973, Philadelphia, 1916, pp. 218-19.

A. That is correct, sir.

Q. Would any part of that amount have been saved if the railways had moved no export grain in 1974?

A. No, sir.*

The fact that the system constant costs would be the same irrespective of whether the grain traffic was carried or not, totally negates the position that since grain is a substantial portion of the total traffic a portion of the system constant costs must be attributable to it.**

It is clear that no portion of the system constant costs can be attributed directly to the statutory grain traffic. The only possible logic for including a statistical apportionment of system constant costs in the total costs of transporting statutory grain by rail is that the total system costs for all traffic combined include both constant and variable costs. From this, it may be argued that the total costs of handling a portion of the system traffic also must include variable and constant costs. There is agreement that in the normal type of cost finding procedures (i.e., cost finding involving commodities whose rates are based on market consideration) there is no need to allocate constant costs. This is

---

*<u>Transcript</u>, Vol.4, p. 557.

**See also Exhibit AMS-17, pp. 40 and 41.

because the ratemaker inherently allocates a portion of the system constant costs to the traffic when he selects the rate which will maximize the revenue contribution (excess of revenue over variable costs) of the traffic.

If the rates of all of the commodities and services of a railway system were market based then this logic dictates that the relevant total cost for the carriage of a particular commodity would be expressed by the formula:

$$TC_i = VC_i + \left(\frac{RC_i - VC_i}{RS - VS}\right) \times (TS - VS)$$

where

TC_i = total cost of the commodity

VC_i = calculated variable cost for the commodity

RC_i = total revenue for the commodity

RS = total revenue for the system
VS = calculated variable cost for the system
TS = total cost of the system

If the system were in perfect balance (for an ongoing, viable enterprise), then the total system revenue (RS) would be equal to the total system cost (TS) and the equation could be written as:

$$TC_i = RC_i$$

Thus under this example, we would arrive at the peculiar notion that the total cost of carrying a particular commodity is equal to the revenue received from the carriage of the commodity.

The Commission finds that logic requires it to reject the notion that somehow revenues are, in part, a determinant of the total relevant costs of transporting a particular commodity. This conclusion is most succinctly stated at page 42 of Exhibit AMS-17.

> Cost is what the railway foregoes to move the traffic. A revenue just equal to cost would be at an indifference level; the railway would be just as well off without the traffic as with it. As a practical matter, a management would not seek a traffic unless revenues were at least a little above cost. The fact that revenue should exceed cost does not properly lead to the nonsense statement that cost exceeds cost.

Interestingly, the railways, the major proponents of including constant costs in the relevant total costs, state:

> It is, therefore, the position of the railways that the costs incurred in the hauling of grain are the relevant costs.*

Clearly, the system constant costs are incurred by the system as a whole and not by the hauling of grain. Indeed,

---

*Summary and Final Argument of Canadian National and CP Rail to the Commission on the Costs of Transporting Grain by Rail, p. 4.

the same total dollars of constant costs would be incurred even if the carriage of grain were not performed. Thus, the Commission must conclude that an allocation of system constant costs is not an integral part of the determination of the relevant costs of transporting any commodity whether it be a commodity that is carried under market based rates or under statutory rates.

Statistical Allocation of System Constant Costs

Given the Commission's answer to the first question* it did not have to address itself to the other two questions raised by this issue. However, the parties to this proceeding spent considerable time and effort in addressing the issue of whether a statistical allocation of constant costs is a reasonable estimate of the revenue that the railways would have received for hauling statutory grain under a market based rate system. For this reason and in recognition of the probability that some will disagree with our previous conclusion, we deem it appropriate to review and comment on this question.**

---

*An allocation of constant costs is not an integral part of the determination of the relevant costs of transporting any commodity, whether it be a commodity that is carried under market based rates or under statutory rates.

**This determination and our comments hereinafter in no way imply the Commission is retreating from its position that its mandate limits its consideration of revenues to a determination of the revenues received by the railways for hauling of statutory grain under contemporary conditions (i.e., the existing statutory rates).

In their initial submissions to the Commission, each railway calculated its total system variable cost and subtracted this from the total system costs to obtain total system constant costs. The ratio of total system constant to total system variable cost was derived and applied to the computed grain traffic variable costs, less solely related costs. The result was considered by the railways to be an identification of the system constant costs that should be attributed to the total cost of moving grain by rail. The actual computations each railway performed for its constant cost calculation for their respective initial submissions are detailed in Schedule XI.

During the Winnipeg hearings and the subsequent discussion of the various cost issues, it became apparent that one of the Commission's objectives, as well as an objective of costing in general, was to obtain costs which were as specific as possible. That is, costs which could be linked very closely to their causative factors. As a result, both railway companies attempted to obtain a greater degree of specificity in their calculation of constant costs for the rebuttal hearings in Regina.

The railways changed their method of determining the allocation of constant costs to grain and recalculated all their previous numbers for constant costs. The total pool of constant dollars was separated into constant dollars which could be associated with Western Canada (i.e., Thunder Bay and West), those associated with Eastern Canada and those which could not be allocated by geographic area.

The constant costs which could be identified specifically with Western Canada were allocated to grain traffic on the basis of gross ton miles. This process consisted of first determining the total western constant costs less the line related costs of the grain dependent lines. Then the ratio of the gross-ton-miles of grain traffic to the total gross-ton-miles of all Western traffic combined* was derived. This ratio was applied to the already determined total Western constant costs to obtain the portion to be charged to the grain traffic.

The constant cost dollars which could not be assigned to a specific geographic area were allocated to grain on the basis of a ratio of residual (unassigned) system constant costs to system variable costs (the ratio method initially employed). The details of this method of computation of constant costs perceived to be applicable to grain traffic

---

*Both gross-ton-mile figures exclude the gross-ton-miles of grain traffic generated on the grain dependent lines.

are described in Schedule XII.

It can be noticed that changing the method of deriving attributable constant costs had a very significant effect on the magnitude of those costs assigned to grain. Using the railways' method employed in their Winnipeg submissions, CP Rail identified over $20.8 million of constant costs attributable to grain traffic. However, changing to the method employed in Regina reduced this amount to $15.3 million or a 26% downward variation in constant costs claimed to be directly attributable to grain traffic. On the other hand, Canadian National initially claimed $25.1 million but this became $31.9 million under the revised methodology -- an upward variation of 27%.

Besides the railway companies, only one other party addressed the method which could be used to allocate constant costs to grain traffic. United Grain Growers (U.G.G.) suggested that an attempt should be made to determine the contribution to constant costs that was provided by the rates on other export bulk commodities and that the average contribution of these other commodities should set the grain contribution level. United Grain Growers stated in their submission that grain would therefore not be:

> ...burdened with a constant cost allocation in excess of that borne by other bulk commodities facing international competition in the market place.*

The suggestion of the United Grain Growers contrasted to the railways' methods of calculating constant cost attribution. The railways relied upon an allocation based on the facilities, volume and utilization of the overall rail plant by grain traffic. U.G.G. would allocate constant costs in relation to a level of "burden" comparable to other commodities regardless of volume or utilization of plant. Both methods are equally arbitrary and indeed U.G.G. pointed out in it's submission that regardless of the allocation method, the actual allocation of constant costs is a matter of public policy.**

In the view of the Commission, the use of the statistical allocations of constant costs as a surrogate for contribution under a market rate is not an acceptable method for determining the constant costs that should be allocated to statutory grain traffic. The Commission is in full accord with the position expressed by Dr. Heaver:

---

*Exhibit U.G.G.-2, p. 30.

**Ibid., p. 28.

THE COMMISSIONER: All right, sir. However calculated the long-run part of the cost would be a calculation showing the cost to the railways of producing the service directly attributable to that service in the long run, is that fair?

THE WITNESS: That is fair.

...

THE COMMISSIONER: At that point, following your theory, I would then have to shift over from any consideration of what it costs the railway to produce the service and determine what contribution to constant cost that commodity or that service would provide given the free play of the market, is that correct?

THE WITNESS: That is correct.

THE COMMISSIONER: And you are saying that is the only way I can make that calculation for constant costs since I do not have free play in the market place at this time, is that correct?

THE WITNESS: That is the final criterion that you have to apply, yes.*

Based on all the evidence presented to it and its own evaluation of system constant costs, the Commission is of the opinion that the total relevant costs of carrying statutory grain by rail are the variable costs. For reasons described above, the Commission believes that statistical apportionment is not a valid estimate of the net revenue the railways would receive if statutory grain were transported on a market rate basis.

---

*Transcript, Vol. 3, pp. 504 and 505.

Market Rates

Virtually all railway freight in Canada, except statutory grain and grain carried under the "At and East rates", is transported under rates that are set by the railways and generally are not subject to regulation. This, of course, is consistent with the current regulatory philosophy which effectively provides that the upper limit of the rates for transportation services should be dictated by competition and the competitive environment to the greatest extent possible. Rates set in this manner are called market or competitive rates.

The upper limit of a competitive rate is dictated by one or more of the following factors:

- The rate level that is, or that would be, charged by existing providers of a transportation service whether they be of the same mode (railways) or of a different mode (motor carriers, airlines, or pipelines).

- The rate level that would entice a potential carrier to make the investment necessary to be able to compete for transportation of the commodity.

- The maximum transportation rate that the commodity can afford to absorb as a cost input and still compete in the market place with the same commodities from other sources or with substitute commodities from the same source or other sources, i.e., the market competitive rate.

The difference between intermodal competition and market competition is identified by the railways at page 30 of Exhibit R-29:

> ...In fact, market competition determines whether there will be any transportation demand and intermodal competition determines only the share any mode will get. In other words, intermodal competition has a role to play only when the rates applicable to a particular traffic are high enough to provide an incentive to the carriers of another mode to become competitive.

The message of this statement is, in our view, equally applicable to intramodal competition and to competition from potential carriers.

With respect to the first two factors, intra and intermodal competition, the Commission listened to considerable discussion but little fact as to the real ability of other modes -- principally motor carrier (existing) and pipeline (potential) -- to compete with the railways for

all or a significant portion of the statutory grain traffic. Most importantly, there are no facts or studies that delineate the rate level at which the statutory grain traffic would be attractive to these other modes. For the foreseeable future, the Commission is convinced that statutory grain traffic will be substantially captive to the railway mode of transportation* and that intermodal price competition for this traffic will be virtually non-existent. The following exchange between Mr. Cormack (Manitobe Pool Elevators) and Mr. Heaver, representing the railways, supports this position.

> Q. MR. CORMACK: Okay. I will accept that interpretation. Now, going to talking about grain and the application of this kind of a principle to grain, I think that it is generally agreed, and I think it was confirmed by the previous witness and was also confirmed by yourself to a certain extent, that with the exception of short-hauls, that grain in fact is really a captive to the rail movement. There is no practical alternative mode of transportation for moving grain into export position. I think this a generally agreed concept.
>
> A. DR. HEAVER: Yes.**

With respect to intramodal competition, the evidence before us indicated that, in all probability, Canadian National and CP Rail would continue to charge the same rate for hauling statutory grain traffic from competitive points

---

*<u>Transcript</u>, Vol. 3, pp. 374-377; Vol. 23, pp. 4350-4353.

**<u>Transcript</u>, Vol. 3, p. 447.

even if the rates were set on a market basis. The absence of potential price differentials between the two transcontinental Railways is shown in the following discussion:

> THE COMMISSIONER: ...if the (statutory) grain rates were set on a market competitive basis would it be reasonable for me to assume they would be the same or at least set on the same structure?
>
> MR. SAUNDERS: I would expect that to be so.*

For the above reasons, the Commission concludes that the upper limit on market based rates for statutory grain traffic would be dictated by its ability to absorb transportation and distribution costs and still remain market competitive. That is, in this particular instance market competition would not only determine whether there will be any demand for transportation service but also the upper limit of the rail rate if such rates were set on a market basis. Under contemporary conditions, this translates into the farmers' ability to pay for rail transportation services.**

---

* _Transcript_, Vol. 30, p. 5988.

** It should be noted that the Commission stated at page 64 in Volume I of its report that:

> ...the revenue need of the railways was outside the Commission's mandate as was a determination of whether or not statutory grain shippers can afford to pay a rail rate equal to or greater than the variable costs incurred by the railways in transporting their traffic.

All parties actively addressed themselves to the question of whether or not grain producers could afford to pay a higher rate than is now being charged and if in fact they could afford to contribute towards constant costs.

CP Rail and Canadian National Railways maintained that there was no question that a higher rate level for grain transportation would not seriously endanger the livelihood of the Western Canadian grain producer. To substantiate these beliefs Professor T.D. Heaver presented testimony to this effect on behalf of the railway companies. In his submission, he concluded that statutory grain could afford to pay rail rates greater than his perceived notion of the railways' estimate of the total variable cost incurred in the transportation of grain by rail.* His testimony stated that there were a number of factors which

> ...support the proposition that, under a free market system, grain would be able to bear more than long-run variable costs of rail transport. They are:
>
> 1. The value of grain has risen substantially in recent years.
>
> 2. Grain bears major variations in the level of other distribution costs to world buyers, without apparent loss of market.

---

*Dr. Heaver did not have the results of the railways' estimates of variable cost as presented to the Commission in Exhibit R-1, CP-4 and CN-2 at the time he prepared his statement (Exhibit R-2) but had an understanding that the variable cost estimate would be about three times the present rate level. (Transcript, Vol. 2, p. 336).

3. Rail charges are a small proportion of grain prices.

4. Rates charged in other segments of the grain handling and distribution system have increased over the years.

5. U.S. grain bears substantially higher rail rates than Canadian Grain.*

To support the statement that the value of grain has risen substantially, Dr. Heaver quoted prices of wheat in store at Thunder Bay since 1963-64. This range of values of wheat is shown on Schedule XIII and purports to show that the value of grain has significantly increased and thus the producer is able to bear increased rail costs.

Professor Heaver's statement was subsequently questioned by the National Farmers Union and the grain elevator companies who stated that the realized price to the producer did not correspond to Thunder Bay asking prices and was, in fact, substantially lower. Furthermore, the Provinces suggested that the prices quoted by Dr. Heaver were not representative of the average price of Canadian grain but instead were the prices for high grade, and therefore expensive, wheat.

In their rebuttal submission, the Alberta Wheat Pool, Manitoba Pool Elevators and Saskatchewan Wheat Pool provided

---

*Exhibit R-2, p. R-2-11.

evidence which attempted to show the average revenue per bushel of grain realized in Western Canada. The Pools' submission showed that for several years the average grain farmer, after subtracting all costs including wages, return on investment and depreciation, actually lost money for each bushel of grain sold. According to the Pools' evidence (which is reproduced as Schedule XIV) it has only been in the past three years (1973, 1974, 1975) that producers have been realizing a gain.

This particular table was the cause for a great deal of discussion during the hearings in Regina. Volume 20 of the Transcript, pages 3725 - 3793, documents the Railways' questioning of the witnesses from the Pool Elevator companies concerning the validity, methodology and interpretation of the Schedule XIV data. Among other things the railways pointed out mathematical errors, double counting of capital costs and the fact that revenues and costs were arbitrarily included and excluded from the numbers contained in the original source documents so as to make the reliability of the submitted table questionable. As was the case with much of Professor Heaver's evidence, the conflicting viewpoints presented by both sides rendered the Pools' Table ineffective as a determinant of the ability of the producer to pay higher freight costs.

Witnesses from Palliser Wheat Growers Association, United Grain Growers, the Pool elevator companies and National Farmers Union all issued words of caution regarding the projection of future grain prices. While they unanimously were not optimistic that prices would remain at present (1975) levels, there was a consensus that the producer could economically afford to incur higher costs for transportation if grain prices could maintain their present high levels. However, all producer organizations agreed that even then, the producer could not bear the brunt of a rail rate three to five times greater than he is now paying. Grain prices were said to be highly volatile and influenced by the world market rather than the costs of production and distribution in Canada. Thus, increased costs could not always be passed on to the purchaser.

To support his second claim, that, in the past, grain has been able to support variations in other distribution costs, Dr. Heaver presented a statistical analysis (reproduced as Schedule XV) for years 1933-1975 tracing the costs of rail, lake and ocean transportation, and interior and port handling. These statistics show that all distribution costs except those of rail transportation have increased and varied since 1933.

Again the facts presented were disputed. Ocean charges, the most significant of the distribution costs shown, were

termed irrelevant for any type of analysis since the buyer, not the producer, pays these costs and that the relationship of these costs between importing nations remains constant. Consequently, there is no relative change or variation in these costs which will affect the competitiveness of the producing country.*

The fact that the rail rates for grain transportation were higher in the United States than in Canada was another reason put forth by Dr. Heaver as support for his contention that producers could bear the financial burden of rail rates set at a level which reflected total variable costs plus a "fair" portion of constant costs. Dr. Heaver's examples of U.S. rail rates are reproduced as Table XI. Dr. Heaver pointed out that Canadian wheat competes in the international market with U.S. grain. Furthermore, he suggested that if U.S. grain producers can bear rail charges two to three times that of their Canadian counterparts and still compete favorably with Canadian grain exports and remain economically viable, then Canadian producers can likewise afford to pay increased freight rate charges.

On the other side of the coin, some parties contended that, to some extent, U.S. producers were shielded from

---

*Transcript, Vol. 3, pp. 429 and 430.

TABLE XI

Selected Data for Carload Movements of Wheat from U.S. Western Trunk Line Territory, 1973

To (Territories)	Average Revenue Per Ton	Average Tons Per Car	Average Haul Per Car
Western Trunk L.	7.84	70.3	322
Official	11.14	85.5	1105
Southwest	13.12	70.0	1077
South	11.92	78.1	1205
Mountain Pacific	18.62	78.2	1392

Data from 1973 Carload Waybill Statistics, U.S. Department of Transportation, 1975.

Source: Exhibit R-2, Table 3.

increased rail rates by direct government subsidies to the producer; that U.S. producers did not have to bear the administration charges of a central marketing board and that it was entirely possible the costs of production in the two countries were not the same. This leads to the conclusion that findings based on a comparison of U.S. and Canadian grain freight rates are merely speculative unless all the various differences between U.S. and Canadian producers are considered.*

---

*Transcript, Vol. 3, p. 369.

The cross-examination of Dr. Heaver revealed that while there is some merit to each of his five considerations, they are not sufficiently well documented to draw any further conclusions regarding the ability of grain to remain competitive in the world market if the Canadian rail transportation rates were substantially greater than the existing stateway rates. They certainly cannot lead to a factually supportable conclusion that grain can absorb rail transportation costs of more than three to four times the existing statutory rates.

The evidence presented to this Commission suggests that, if the statutory grain were transported at a market rate level, the factor controlling the level of the rate would be the ability of the shipper (grain producer) to pay. Thus, an allocation of system constant costs to statutory grain traffic is dependent upon the analyst's ability to determine the maximum rate the shipper could afford to pay. Such determination would be most difficult, if not impossible, and clearly, could not be accomplished on the basis of the evidence presented to this Commission, as was noted earlier:

> ...the evidence on the ability of the shipper to pay a market based rate, at best, was inconclusive and did not provide a basis for even a value judgment on this matter.*

---

*Commission on the Costs of Transporting Grain by Rail, Vol. I, p. 66.

SCHEDULES

Status of Research Recommended in
Reasons for Order No. R-6313 Concerning Costs Regulations

Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Freight Car Depreciation - Page 364 "the railways should conduct a study in depth of the causes of freight car deterioration under Canadian operating conditions."	CN are following C.T.C. directions of allocating 80% of freight car costs by car days and 20% by car miles. No additional "in depth" studies have been initiated. Information is not presently available but CN's present data base will provide enough information after "several years" of data accumulation.	CP are following C.T.C. directions of allocating 80% of freight car costs by car days and 20% by car miles. No additional "in depth" studies have been initiated. Data upon which to undertake such a study is not available. CP Rail recommends this study be deleted from the list of research studies required by R-6313 or be given a very low priority.	Page 135, Volume I "For reasons of consistency, we have rejected CP Rail's use of the 100 percent factor and have used the 80-20 basis in our cost study."
Fuel - Page 365 - "The railways have indicated their intention to conduct further research into the Davis Formula, and we agree that this should be carried out as soon as it is feasible to do so. Until the Committee has received and analyzed the results of this study, each railway should continue to use its present method."	CN are in the midst of accumulating enough data to undertake a study which would provide sufficient information to test and calibrate the Davis Formula.	CP are continuing to use their own costing procedures for fuel. No intensive research has been initiated into the use of the Davis formulas. As a result of the formula's inability to consider the human element in train operations, wind speed and directions, physical aspects of equipment and engine idling time, CP Rail recommend the Davis formula not be used and that this item be deleted from the list of special studies.	For calculation of fuel cost this Commission used the methods proposed by the two railways. We have, as did the C.T.C. in 1969, recommended further research into the use of the Davis Formula.

Status of Research Recommended in
Reasons for Order No. R-6313 Concerning Costs Regulations

Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Other Railway Taxes - Page 369 - "The best treatment of property taxes would be to isolate each taxable property account for more than, say $50,000 in tax payment annually.... Pending the rather extensive studies required for this treatment, the railways should allocate property taxes according to the Canadian Pacific assignment of the Road Property accounts (Accounts 1 through 47) for cost of capital calculations."	Municipal and public taxes are presently identified directly for branch lines. Work is underway to develop similar data for passenger terminals. For all other freight operations CN allocates property taxes according to CP assignment of road property accounts. Because of the work involved in isolating taxes payable for other [illegible] only branch lines and passenger terminals should be so treated.	CP have undertaken extensive studies for major passenger terminals and annually perform direct studies of property taxes for the subsidized branch lines. CP recommend that no further studies be undertaken until [illegible] the method-ology of those studies already submitted to them.	For property taxes on branch lines, the Commission and the railways used specific allocation. For all other taxes the railway allocation method was employed.
Traffic Expenses - Page 372 - "Until further research can be carried out, Canadian Pacific should adopt the Canadian National method of assigning traffic expense by commodity groupings....Accordingly, we have decided that traffic expense should be excluded from the costing of grain traffic unless the railway can demonstrate that the grain traffic in question actually involves functions covered by traffic expense."	Follows R-6313.	Extensive studies have concentrated in the area of passenger traffic expense and these studies have been filed with the C.T.C. For all freight traffic including grain, CP Rail uses CN's variability percentages and follows R-6313 directions.	The Commission accepted CP Rail's submission which included an allowance for traffic expenses. CN did not include these expenses in their submission and thus no costs were included for them by the Commission.

Status of Research Recommended in
Reasons for Order No. R-6313 Concerning Dosts Regulation

Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Switching Times - Page 388 - "The Committee believes that the railways have ignored this element in switch ing costs for too long. Accordingly, the railways will be directed to institute the following studies immediately: (1) A study to determine the average cut size used in the switching of grain cars at major grain cars at major grain-handling yards. (2) A study to determine whether other broad classes of traffic experience consistent variations from the average cut size of all freight traffic moving through major yards and terminals. (3) A study to determine the cost variations resulting from differences in car lot sizes in each of the switching elements."	Specific grain switching studies are being conducted at all major grain handling terminals. Studies distinguishing characteristics of other commodities have not been performed.	CP undertook, in 1967, detailed studies of 12 terminals across Western Canada. CP believes the results from these studies reflect the specific handling times given to various commodity groupings as they were processed through each terminal. In addition, they have undertaken a new study, specifically related to grain traffic, which they believe will update the switching statistics for grain traffic	The Commission used the results reported by the railways' special grain switching studies.
General Expenses - Page 373 - "The Committee has decided that the Canadian Pacific method imposes a rather arbitrary treatment of these expenses, and that a reasonable adjustment is to reduce the expense allocation from 75% to 60% variable pending results of further research indicating need for a change."	NOT REQUIRED. Present method accepted by the C.T.C.	In 1973, CP Rail undertook a study which used data from 72 U.S. railroads. The results of this analysis would increase the variability factor. This study and results have not yet been accepted by the C.T.C.	The Commission approved and used CP Rail's method of treating General Expenses as 100% variable with the independent explanatory expense dollars.

Status of Research Recommended in Reasons for Order No. R-6313 Concerning Costs Regulations			
Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Empty Return Ratios & Car Days - Page 384 - "The Committee will direct the railways to continue their development of new methods of attribution. In developing these methods, car movements should be traced from actual car records in order to determine a representative assignment of car days for each movement. Allowances should be made for repair time, seasonality, week-end or holiday layovers, cleaning, weighing, and the like. All systems of car tracing should show not only the dates indicating time spent at stations of origin and destination, but also the dates when cars either passed through or were stored at key points."	CN has produced a file of car cycle records (one for each load) for all loaded car movements. A report has been produced showing the car cycle and empty return ratio for each block of traffic defined by car load centre origin, car load centre destination, and car type.	A special study involving a 10% sampling of all export grain originating in Western Canada has been completed by CP Rail. Studies of other commodities are undertaken periodically by train run and car type.	The Commission used the car cycle data submitted by the railways. This data reflected the results of their special studies related to this issue.
Road Property Investment - Page 350 "EBS recommended that the ultimate solution is for Canadian National to develop an investment function of its own... We agree with the EBS recommendations and we adopt them."	CN has undertaken to develop a road property inventory of a sample of 31 subdivisions. This study is before the C.T.C. for review and analysis.	NOT REQUIRED. Present method accepted by the C.T.C.	The Commission used the Canadian Pacific gross investment functions to determine CN's road property expenses.

Status of Research Recommended in
Reasons for Order No. R-6313 Concerning Costs Regulations

Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Tunnels, Bridges & Culverts - Page 376 - "A specific determination of the variability of this account has not been made because it is normally buried in the account 202 complex for which a composite variability is determined by regression analysis. The railways should, therefore, analyze this account independently to determine the extent of its variability....In the meantime, the account should be excluded from the account 202 complex.	No studies have been carried out for this issue and thus it is excluded from the cost calculation as directed by R-6313.	CP Rail has completed, and submitted to the C.T.C., its study on these expenses. The C.T.C. has not yet completed its review of the studies and CP continues to exclude all tunnel, bridge, and culvert expenses.	The Commission treated these as fixed costs and excluded them from the study.
Train Costs - Page 380 - "There are two problems involved here, one of which is the averaging of costs in both directions by train run and the other is to find the basis of assigning train costs to particular traffic....At the same time, both Canadian National and Canadian Pacific should continue to study this matter in detail and report the results to the Committee. Consideration should be given to variables such as car miles, gross ton miles, train switching hours, length of train, and length of sidings."	CN have developed enough data to compute train costs on either cars or gross tons. They are studying the feasibility of new operating statistics system which would allow them to test switching hours and length of train.	CP Rail are actively attempting to improve the quality of the car mile data to permit the required studies to be undertaken. This will be a lengthy task and CP have requested the C.T.C. to assign a low priority to this research.	Page 58, Volume I "the train-miles related to statutory grain traffic may be seen to be properly treated as 100 percent variable with the totality of statutory grain ton-miles....For the purposes of costing the transportation of grain by rail, this Commission accepted the procedure as detailed in the railway Costing Manuals."

Status of Research Recommended in Reasons for Order No. R-6313 Concerning Costs Regulations			
Recommended Research Cited from Reasons for Order No. R-6313	Status		Method Employed by This Commission
	Canadian National	C.P. Rail	
Communications - Page 374 - "We are not satisfied that sufficient study has been made of this matter. We direct that further research be conducted and the result be provided to the Committee at the earliest date possible."	CN are using the 70% variability factor required by the C.T.C. They have not initiated any studies to separate fixed and variable expenses.	CP are using the 70% variability factor required by the C.T.C. They have completed their research into communications expenses and have forwarded the results to the C.T.C. They estimate that using the 70% variability factor [illegible] this cost element by 9%.	Page 53, Volume I "we treated this expense as 100 percent variable for both Canadian National and CP Rail."
Road Locomotive Repair - Page 375 - "We agree with the revised Canadian Pacific procedure and direct that Canadian National expand further its horsepower groupings for locomotives over 1200 horsepower. Both railways should immediately begin accumulating the necessary statistics to test whether locomotive costs based on fuel consumption are more appropriate than present procedures."	CN are unwilling to undertake expensive studies in this area. They contend that it would require installing metering devices and computer systems. They have dropped horsepower ratings as required by R-6313.	CP contend that there is no evidence to show that fuel may be a better predicator of diesel repair costs than diesel unit miles by type of locomotive and thus are unwilling to initiate time consuming, expensive studies in this area.	The Commission found that some logic still exists for suggesting that fuel consumption is a more precise variable for measuring locomotive repairs than is locomotive unit-miles. For this Commission locomotive unit-miles were used and a recommendation was made to the railways to carry out the necessary tests to accept or reject the fuel theory.

Source: CN & CP Documents filed with this Commission on October 9, 1975 and Report Filed by CP in Response to Request of Provinces: AMS Request C-8, December 18, 1975.

Provincial Analysis of Railway Regressions

CNR Regressions
(Adapted from Exhibit No. CN-5)

	Used by CNR	Visual Examination Suggested East-West Differences	East-West Adjustment by Provinces
Roadway Maintenance Superintendence:			
1. - Labour	x	x	x
2. - Other	x	x	none
Roadway Maintenance Complex:			
3. - Labour	x	x	combined*
4. - Other	x	x	combined*
Maintenance of Station Buildings:			
5. - Labour	x	x	none
6. - Other	x	x	none
Maintenance of Shops and Enginehouses:			
7. - Labour	x	x	none
8. - Other	x	x	none
Train Control:			
9. - Labour	x	x	none
10. - Other	x	x	none
Maintenance of Power Plant Systems:			
11. - Labour	x	no	none
12. - Other	x	no	none
Line Point Overhead Expenses:			
13. - Labour	x	x	Combined 13 and 14
14. - Material	x	no	
Steam, Power and Heat Operations:			
15. - Labour	x	no	none
16. - Material	x	no	none

*Provinces combined labour and material for CN and CP for West only to produce one regression.

Provincial Analysis of Railway Regressions

CNR Regressions
(Adapted from Exhibit No. CN-5)

		Used by CNR	Visual Examination Suggested East-West Differences	East-West Adjustment by Provinces
	Freight Sales:			
17.	- Labour	**	**	**
18.	- Other	**	**	**
	Transportation Superintendence and Overhead:			
19.	- Labour	x	x	none
20.	- Material	x	no	none
	Station Employees and Expenses:			
21.	- Labour	x		none
	Yard General Expenses:			
22.	- Labour	x	x	x
23.	- Other	x	x	none
	Yard Switchmen:			
24.	- Labour	x	no	none
	Area Administrative - General:			
25.	- Labour	x	no	none
26.	- Other	x	no	none
	Area Administrative - Transportation:			
27.	- Labour	x	no	none
28.	- Material	x	no	none
	Area Administrative - Equipment:			
29.	- Labour	x	no	none
30.	- Other	x	no	none

**Not used in costing grain.

Provincial Analysis of Railway Regressions

CP Rail Regressions
(Adapted from Exhibit No. CP-15)

	Used by CP Rail	Visual Examination Suggested East-West Differences	East-West Adjustment by Provinces
Roadway Maintenance Superintendence:			
1. - Labour	x	x	none*
2. - Other	x	x	none
Roadway Maintenance Complex:			
3. - Labour	x	x	combined**
4. - Other	x	x	combined**
Roadway Investment Complex:			
5. - Depreciation	x	x	none
6. - Gross Investment	x	x	none
Maintenance of Station Buildings:			
7. - Labour	x	x	none
8. - Other	x	x	none
Station Buildings:			
9. - Depreciation	x	x	none
10. - Gross Investment	x	x	none
Maintenance of Water and Fuel Stations:			
11. - Labour	x	no	none
12. - Other	x	no	none
Water and Fuel Stations:			
13. - Depreciation	x	x	none
14. - Gross Investment	x	x	none
Maintenance of Shops and Enginehouses:			
15. - Labour	x	x	x
16. - Other	x	x	x

* For CN, this group was split East and West.
** Provinces combined labour and material for CN and CP for West only to produce one regression.

Provincial Analysis of Railway Regressions

CP Rail Regressions
(Adapted from Exhibit No. CP-15)

	Used by CP Rail	Visual Examination Suggested East-West Differences	East-West Adjustment by Provinces
Maintenance of Signals, Train Control:			
17. - Labour	x	x	none
18. - Other	x	x	x
Signals			
19. - Depreciation	x	no	none
20. - Gross Investment	x	no	none
Maintenance of Power Plant Systems:			
21. - Labour	x	no	none
22. - Other	x	no	none
Superintendence of Equipment Maintenance:			
23. - Labour	x	x	x
24. - Other	x	x	none
Maintenance of Shop and Power Plant Machinery:			
25. - Labour	x	x	none
26. - Other	x	x	x
Superintendence of Transportation:			
27. - Labour	x	x	none
28. - Other	x	x	none
Station Employees and Expenses:			
29. - Labour	x	x	none
30. - Yardmasters and Clerks	x	x	none***

***Yard General Expenses - Other on CN were split East and West.

Provincial Analysis of Railway Regressions

CP Rail Regressions
(Adapted from Exhibit No. CP-15)

	Used by CP Rail	Visual Examination Suggested East-West Differences	East-West Adjustment by Provinces
Shops and Enginehouses			
31. - Depreciation	x	x	x
32. - Gross Investment	x	x	x
Shop Machinery:			
33. - Depreciation	x	x	none
34. - Gross Investment	x	x	none
Power Systems:			
35. - Depreciation	x	no	none
36. - Gross Investment	x	no	none
Power Plant Machinery:			
37. - Depreciation	x	x	x
38. - Gross Investment	x	x	x

Original CN and CP Regressions and Replacements Suggested by the Provinces (AMS)

Canadian National

I. Road Maintenance Superintendence-Labour (RMS)

CN: RMS = 758,272 + 0.0501 · RMCX $\qquad R^2 = 0.52$
(2.45) (3.92) $\qquad$ Observations = 16

AMS:

EAST: RMS = -279,330 + 0.1111 · RMCX $\qquad R^2 = 0.84$
(7.24) $\qquad$ Observations = 16

WEST: RMS = (-279,330 + 1,137,356) + (0.1111 - 0.0743) (RMCX)
(2.61) (7.24) (-4.03)

Simplified: = 858,026 + 0.0368 · RMCX

Where RMCX is the dollars expense in the road maintenance complex (a/c 202CX)

II. Yard General Expenses-Labour (YGE)

CN: YGE = 11,970 + 1.7019 · YSM $\qquad R^2 = 0.65$
(0.03) (5.11) $\qquad$ Observations = 16

AMS:

EAST: YGE = 219,435 + 1.7437 · YSM $\qquad R^2 = 0.075$
(6.13) $\qquad$ Observations = 16

WEST: YGE = (219,435) + (1.7437 - 0.9689) (YSM)
(6.13) (2.34)

Simplified: = 219,435 + 0.7748 · YSM

Where YSM is yard switching miles

III. Shop General Expenses-Labour Plus Materials (LS)

CN: Labour: LS=-5,486+0.5336·L+0.6501·F+0.3123·SGP+0.6052·W
(0.57) (25.46) (16.18) (9.89) (0.90)

R^2=0.89
Observations=191

CN: Materials: LS= 1,442+0.1067·L+0.1076·F+0.0647·SGP-0.0382·W
(0.53) (18.15) (9.55) (7.31) (0.20)

R^2=0.76
Observations=191

AMS: East: LS=-4,616+0.3865·SGP+0.7345·LFW
(5.86) (23.76)

R^2=0.86
Observations=159

West: LS=-4,616+0.3865·SGP+0.7345·LFW-0.0893·LFW
(5.86) (23.76) (2.28)

simplified: =-4,616+0.3865·SGP+0.6452·LFW

where SGP is labour portion of maintenance and servicing of passenger train cars, L is labour portion of maintenance and servicing of diesel locomotives and steam generator units, F of freight train cars and W of work equipment.

Note: Bracketed term beneath each coefficient is the t-value of that coefficient.

CP Rail

I. Signals Maintenance, Operation and Dispatching-Materials (TC)

CPR: $TC= 2,251+0.3666\cdot TH+0.0350\cdot SM$
$(3.34) \quad (4.73)$

$R^2=0.61$
Observations=22

AMS: East: $TC=-11,571+1.4986\cdot TH+0.2176\cdot SM$

$R^2=0.72$
Observations=22

West: $TC=-11,571+1.4986\cdot TH+0.2176\cdot SM-0.1048\cdot SM$
$(4.42) \quad (5.92) \quad (2.58)$

simplified: $=-11,571+1.4986\cdot TH+0.1128\cdot SM$

where TH represents train hours and SM switching miles

II. Maintenance of Shops and Enginehouses-Labour (MSL)

CPR: $MSL= 423+0.0183\cdot DLM$
(7.15)

$R^2=0.71$
Observations=23

AMS: East: $MSL= -2,686+0.0242\cdot DLM$
(7.86)

$R^2=0.79$
Observations=23

West: $MSL= -2,686+0.0242\cdot SLM-0.0102\cdot DLM$
$(7.86) \quad (2.77)$

simplified: $= -2,686+0.0140\cdot DLM$

where DLM represents diesel locomotive maintenance complex

III. Maintenance of Shops and Enginehouses-Materials (MSM)

CPR: $MSM=-4,051+0.0103\cdot DLM$
(7.85)

$R^2=0.75$
Observations=23

AMS: East: $MSM=-1,641+0.0058\cdot DLM$
(5.13)

$R^2=0.91$
Observations=23

West: $MSM=-1,641+0.0058\cdot DLM+0.0079\cdot DLM$
$(5.13) \quad (5.89)$

simplified: $=-1,641+0.0137\cdot DLM$

IV. Equipment Maintenance Superintendence-Labour (EMS)

CPR: $EMS= 28,211+0.0212\cdot EM$
(12.12)

$R^2=0.86$
Observations=25

AMS: East: $EMS= 23,995+0.0180\cdot EM$
(10.50)

West: $EMS= 23,995+0.0180\cdot EM+0.0080\cdot EM$
(10.50) (3.46)

simplified: $= 23,995+010260\cdot EM$
0.0260

where EM denotes direct equipment maintenance

V. Maintenance of Shop and Power Plant Machinery-Materials (PPM)

CPR: $PPM=-13,164+0.0096\cdot MSE$
(4.32)

$R^2=0.45$
Observations=25

AMS: East: $PPM=-26,905+0.0070\cdot MSE$
(3.56)

West: $PPM=-26,905+0.0070\cdot MSE+0.0101\cdot MSE$
(3.56) (3.60)

simplified: $=-26,905+0.0170\cdot MSE$

where MSE represents direct equipment maintenance and station employee expenses

VI. Shops and Enginehouses-Depreciation (DSE)

CPR: $DSE= 7,967+0.0064\cdot EM$
(5.58)

$R^2=0.58$
Observations=25

AMS: East: $DSE= 10,335+0.0082\cdot EM$
(6.85)

$R^2=0.58$
Observations=25

West: $DSE= 10,335+0.0082\cdot EM-0.0045\cdot EM$
(6.85) (2.79)

simplified: $= 10,335+0.0037\cdot EM$

VII. Power Plant Machinery-Depreciation and Gross Investment* (GIP)

Gross Investment:

CPR: $GIP=-74,852+0.03425 \cdot MSE$
(4.3)

$R^2=0.54$
Observations=18

AMS: East: $GIP=-20,662+0.0396 \cdot MSE$
(5.46)

$R^2=0.67$
Observations=18

West: $GIP=-20,662+0.0396 \cdot MSE-0.0253 \cdot MSE$
(5.46) (2.43)

simplified: $=-20,662+0.0143 \cdot MSE$

Notes: 1. Bracketed term beneath each coefficient is the t-value of that coefficient.

2. Differing number of observations arise from inclusion of some maintenance shops, or from combination of divisions or exclusion of divisions with zero observations.

*Depreciation and gross investment equations are identical except for magnitude of coefficients (depreciation coefficients are 2.5% of gross investment coefficients).

CP Rail

Analysis of System Unit Costs Applied to Western Canada

Account			Number of Western Residuals*		West Net Residual* Difference	West Expense
			+	−	$	$
201 CX	Superintendence of Road Maintenance	Labour	5	5	-122,412	4,780,953
		Other	5	5	- 54,775	1,492,077
202 CX	Roadway Maintenance	Labour	5	4	+ 68,980	20,795,081
		Other	3	6	-725,941	9,556,192
227	Maintenance of Stations and Office Buildings	Labour	5	5	- 68,717	739,423
		Other	4	6	- 61,391	465,622
231	Maintenance of Water and Fuel Stations	Labour	5	5	- 5,702	84,500
		Other	4	6	- 4,551	73,455
235	Maintenance of Shops and Engine-houses	Labour	5	5	+226,912	845,769
		Other	4	6	-173,036	756,727
249 CX	Maintenance of Signals, Operation and Dispatching	Labour	4	6	+ 80,524	6,907,058
		Other	8	2	+202,119	1,503,517
253	Maintenance of Power Plant Systems	Labour	6	4	+ 7,730	60,944
		Other	6	4	- 759	33,068
301 CX	Superintendence of Equipment Maintenance	Labour	5	7	-108,778	1,734,709
		Other	5	7	- 46,706	836,010
302	Maintenance of Shop and Power Plant Machinery	Labour	6	6	-233,571	1,786,100
		Other	7	5	-267,110	856,235
371 CX	Superintendence of Transportation	Labour	4	6	-264,370	6,169,282
		Other	2	8	-422,825	4,554,947
373 CX	Station Employees and Expenses	Labour	7	3	+1,192,087	11,593,862
377	Yardmasters and Clerks	Total	4	6	+111,502	7,616,446
266-2 1/2	Depreciation on Roadway	Deprec	4	5	+381,253	13,113,986
CX	Cost of Capital on Roadway	C. of C.	4	5	+1,576,789	93,693,718

CP Rail

Analysis of System Unit Costs Applied to Western Canada

Account			Number of Western Residuals* +	Number of Western Residuals* -	West Net Residual* Difference	West Expense
			+	-	$	
266-16	Depreciation on Stations and Office Buildings	Deprec.	5	5	+ 18,299	525,203
-16 1/2	Cost of Capital on Station and Office Buildings	C. of C.	5	5	-123,287	4,553,451
266-18	Depreciation on Fuel and Water Stations	Deprec.	7	3	+ 7,386	59,730
-19	Cost of Capital on Fuel and Water Stations	C. of C.	7	3	+ 67,341	542,904
266-20	Depreciation on Shops and Engine-houses	Deprec.	8	4	+ 93,245	389,329
-20	Cost of Capital on Shops and Enginehouses	C. of C.	8	4	+728,357	3,040,777
266-27	Depreciation on Signals	Deprec.	7	3	+215,954	756,870
-27	Cost of Capital on Signals	C. of C.	7	3	+1,139,371	3,993,260
266-29	Depreciation on Power Plants and Systems	Deprec.	7	5	- 1,623	70,111
-31	Cost of Capital on Power Plants and Systems	C. of C.	7	5	- 18,599	375,281
305-59	Depreciation on Shop Machinery	Deprec.	8	4	- 42,120	362,549
-59	Cost of Capital on Shop Machinery	C. of C.	8	4	-342,470	2,947,681
305-60	Depreciation on Power Plant Machinery	Deprec.	5	5	+ 12,100	28,517
-60	Cost of Capital on Power Plant Machinery	C. of C.	5	5	+ 66,885	157,614

* - Means prediction is <u>less</u> than actual; + means that prediction is <u>more</u> than actual.

Canadian National Railways

Analysis of System Unit Costs Applied to Western Canada

Account			Number of Western Residuals –	Number of Western Residuals +	West Net Residual Difference	West Expense
			–	+	$	$
461	Yard General Expenses	Labour	0	6	+3,394,952	4,658,852
		Other	0	6	+266,549	563,345
215 L	Roadway Maintenance	Labour	2	4	- 731,054	27,037,874
		Other	3	3	+ 818,855	8,740,582
463	Yard Switchmen	Labour	2	4	+ 215,060	460,452
390	Steam Power & Heat	Labour	2	4	- 96,270	416,930
		Other	1	5	+ 158,722	551,160
245	Power Plant System	Labour	2	4	+ 25,606	133,098
		Other	2	4	- 34,424	147,763
230	Maintenance of Shop & Enginehouses	Labour	1	5	+ 115,259	788,087
		Other	2	4	+ 39,878	554,381
210	Road Maintenance Superintendence	Labour	2	4	+ 519,090	3,707,255
		Other	3	3	+ 92,233	806,611
220	Maintenance of Station & Office Building	Labour	2	4	+ 26,131	1,305,605
		Other	3	3	+ 2,704	656,266
370	Shop General Expenses	Labour	32	25	+ 65,999	12,700,955
		Other	23	34	+ 273,156	2,034,464
462	Station Employees and Expenses	Labour	3	8	+1,132,172	4,181,336
441	Train Control	Labour	3	3	-1,015,382	8,026,482
		Other	1	5	- 7,450	1,119,033
485	General Transportation Superintendence	Labour	3	3	+ 54,647	3,500,109
			3	3	- 103,125	1,275,157

* – Means prediction is less than actual; + means prediction is more than actual.

CP ROADWAY MAINTENANCE REGRESSION TESTS

TEST 1 - SYSTEM; EXCLUDING DEFERRED MAINTENANCE

- Labour =125,214+0.1144·MGTM+0.5036·YTSM+921.08·RM+1.0087·GI
  T-value (6.51) (3.36) (1.59) (0.48)

  r^2=0.91; coefficient of variation=17.1%*

- Materials =90,542+0.0824·MGTM+0.0626·YTSM-742.90·RM+3.8754·GI
  T-value (6.35) (0.57) (1.74) (2.48)

  r^2=0.82; coefficient of variation=28.7%

variable cost=$5,060,667**

TEST 2 - SYSTEM; EXCLUDING DEFERRED MAINTENANCE; NO GRADIENT FACTOR

- Labour =141,173+0.115·MGTM+0.5310·YTSM+1151.29·RM
  T-value (6.92) (3.93) (3.69)

  r^2=0.90; coefficient of variation=16.7%

- Materials =151,855+0.0713·MGTM+0.1682·YTSM+141.55·RM
  T-value (5.13) (1.44) (0.53)

  r^2=0.75; coefficient of variation=32.8%

variable cost=$4,864,332

*Coefficient of variation for original CP regression:
labour = 13.8%, other = 30.2%
for AMS proposed regression: labour + other = 44.9%

**Variable cost of direct shipment study traffic including relevant overhead for original CP regression = $5,140,373; for AMS proposal = $5,569,176.

TEST 3 - SYSTEM; EXLCUDING DEFERRED MAINTENANCE; NO GRADIENT; REGIONAL DUMMY

- Labour: East=77,443+0.0764·MGTM+0.6860·YTSM+1373.40·RM
  T-value (2.68) (4.19) (4.27)

  West=77,443+0.0764·MGTM+0.0489·MGTM+0.6860·YTSM-0.3976·YTSM+1373.40·RM
  T-value (2.68) (1.93) (4.19) (1.80) (4.27)

  =77,443+0.1253·MGTM+0.2884·YTSM+1373.40·RM

  r^2=0.93; coefficient of variation=15.5%

- Materials:
  East=124,223+0.0342·MGTM+0.1985·YTSM+358.44·RM
  T-value (1.34) (1.35) (1.24)

  West=124,223+0.0342·MGTM+0.0401·MGTM+0.1985·YTSM-0.1416·YTSM+289.16·RM
  T-value (1.34) (1.76) (1.35) (0.71) (1.24)

  =124,223+0.0743·MGTM+0.0569·YTSM+289.16·RM

  r^2=0.79; coefficient of variation=31.8%;

variable cost = $4,960,401

TEST 4 - SYSTEM; EXCLUDING DEFERRED MAINTENANCE; REGIONAL DUMMY

- Labour: East=57,413+0.0826·MGTM+0.6689·YTSM+1103.33·RM+1.1141·GI
  T-value (2.64) (3.92) (1.84) (0.54)

  West=57,413+0.0826·MGTM+0.0469·MGTM+0.6689·YTSM-0.4188·YTSM+1103.33·RM+1.1141·GI
  T-value (2.64) (1.79) (3.92) (1.83) (1.84) (0.54)

  =57,413+0.1295·MGTM+0.250·YTSM+1103.33·RM+1.1141·GI

  r^2=0.93; coefficient of variation=15.9%

- Materials:
  East=57,355+0.0550·MGTM+0.1414·YTSM-543.17·RM+3.7195·GI
  T-value (2.28) (1.08) (1.18) (2.35)

  West=57,355+0.0550·MGTM+0.0336·MGTM+0.1414·YTSM-0.2122·YTSM-543.17·RM+3.7195·GI
  T-value (2.28) (1.67) (1.08) (1.20) (1.18) (2.35)

  =57,355+0.0886·MGTM-0.0708·YTSM-543.17·RM+3.7195·GI

  r^2=0.85; coefficient variation=27.8%

variable cost = $5,179,851

Roadway Investment and Depreciation, 2 1/2 CX Commission's Analysis - Main Line Only, CP Rail			
		Depreciation	Gross Investment
Independent Variables:	X1 MGTM		
	X2 YTSM		
	X3 Miles of Roadway		
Number of Observations:	21		
Number of Years:	*		
Regression Coefficients:	b1	0.06905	3.69737
	b2	0.44159	14.59655
	b3	559.45972	23231.25391
R^2 (Coefficient of Determination):		0.93715	0.91108
T-Value:	b1	6.07784	5.64147
	b2	4.63142	2.65365
	b3	2.54035	1.82851
Intercept:		30188.75	1464490.00
F-Value:		40.878	27.680

MGTM - Thousand Gross Ton Miles.

YTSM - Yard and Train Switching Miles.

*For the non-deferred lines, the normalized 1970-1974 average was used. For the deferred maintenance lines, the 1974 data was used as a representative proxy in the "netting out" process.

Roadway Investment and Depreciation, 2 1/2 CX C.P. Rail Analysis - All Lines		Depreciation	Gross Investment
Independent Variables:	X1 MGTM		
	X2 SM		
	X3 Roadway Miles		
	X4 Gradient Index		
Number of Observations:	21		
Number of Years:	5		
Regression Coefficients:	b1	0.08159	4.01676
	b2	0.44968	14.40914
	b3	359.64828	14369.16366
	b4	0.96616	77.53845
R^2 (Coefficient of Determination:		0.96495	0.96143
T-Value:	b1	9.088	9.043
	b2	5.748	3.722
	b3	3.138	2.533
	b4	0.944	1.532
Intercept:		-11360.63061	-535794.65730
F-Value:		110.128	99.695

MGTM - Thousand Gross Ton Miles.

SM - Switching Miles.

Roadway Investment and Depreciation, 2 1/2 CX C.P. Rail Analysis*-All Lines		Depreciation	Gross Investment
Independent Variables:	X1 MGTM		
	X2 SM		
	X3 Roadway Miles		
Number of Observations:	21		
Number of Years:	5		
Regression Coefficients:	b1	0.80249	3.90911
	b2	0.45631	14.94126
	b3	457.55090	22226.29910
R^2 (Coefficient of Determination):		0.96300	0.95577
T-Value:	b1	9.082	8.579
	b2	5.875	3.731
	b3	9.385	8.841
Intercept:		53193.14617	4644942.52785
F-Value:		147.478	122.448

MGTM - Thousand Gross Ton Miles.

SM - Switching Miles.

*The regression analysis in this table is a reproduction of two of the several tests which CP Rail performed to determine the most appropriate coefficients for this account. These results were not used by CP Rail for cost calculations. The results which CP Rail did use are shown in Schedule VII, page 2 of 3 hereto. This analysis is reproduced for this report to provide a direct comparison with the statistical results of the Commission analysis (page 1) which does not include the gradient index as an independent variable.

Roadway Maintenance Regression Analysis
Grain Lines Only*
Canadian National

		Labour	Material
Independent Variable:	MGTM, TSM, Roadway Miles		
Number of Observations:	65		
Number of Years:	1		
Regression Coefficients:	b1	207.85150	46.36130
	b2	1.49276	-0.63900
	b3	1152.19702	277.69653
R^2 (Coefficient of Determination):		0.87364	0.79576
T-Value:	b1	1.80500	1.48269
	b2	0.60068	-0.94693
	b3	7.08814	6.29137
F-Value:		63.400	33.955
Intercept:		-6490.59766	-1990.19922

MGTM - Thousand Gross Ton Miles.

TSM - Train Switching Miles.

*This analysis excludes data from the Big River, Inwood and Herchemer Subdivisions.

Roadway Investment and Depreciation Regression Analysis
Grain Lines Only*
Canadian National

		Depreciation	Gross Investment
Independent Variables:	MGTM, TSM, Roadway Miles		
Number of Observations:	65		
Number of Years:	1		
Regression Coefficients:	b1	66.04601	684.92505
	b2	-0.01939	2.37718
	b3	541.00000	4440.77344
R^2 (Coefficient of Determination:		0.92961	0.96001
T-Value:	b1	1.87710	3.09255
	b2	-0.02550	0.49735
	b3	10.89227	14.20410
F-Value:		125.126	231.262
Intercept:		1299.08591	18467.06250

MGTM - Thousand Gross Ton-Miles.

TSM - Train Switching Miles.

*This analysis excludes data from the Big River, Inwood and Herchemer Subdivisions.

Roadway Maintenance Regression Analysis
Grain Lines Only
C.P. Rail

		Labour	Material
Independent Variables:	Roadway Miles, MGTM, TSM		
Number of Observations:	67		
Number of Years:	1		
Regression Coefficients:	b1	785.72681	235.05913
	b2	0.17925	0.03893
	b3	2.36808	0.73535
R^2 (Coefficient of Determination):		0.96430	0.70438
T-Values:	b1	3.28988	2.82782
	b2	0.83343	0.50224
	b3	3.21508	2.76994
F-Value:		29.318	20.679
Intercept:		-16470.11718	-5721.63672

MGTM - Thousand Gross Ton-Miles.

TSM - Train Switching Miles.

Roadway Investment and Depreciation Regression Analysis Grain Lines Only C.P. Rail		Depreciation	Gross Investment
Independent Variables:	Roadway Miles, MGTM, TSM		
Number of Observations:	67		
Number of Years:	1		
Regression Coefficients:	b1	714.56850	5277.19922
	b2	0.04793	0.11401
	b3	-0.15067	-2.68782
R^2 (Coefficient of Determination):		0.96430	0.94214
T-Values:	b1	17.07140	14.12497
	b2	1.22788	0.32720
	b3	-1.12707	-2.25261
F-Value:		278.446	165.882
Intercept:		-756.88281	-8878.63281

MGTM - Thousand Gross Ton-Miles.

TSM - Train Switching Miles.

Normalization Period in CP Regression Analyses*		
Description	Account	Normalization Period (Years)
Superintendence of Road Maintenance	201-CX	3
Maintenance of Roadway	202-CX	5
Maintenance of Stations and Office Buildings	227	3
Maintenance of Water and Fuel Stations	231	3
Maintenance of Shops and Enginehouses	235	3
Maintenance of Signals, Train Control	249-CX	3
Maintenance of Power Plant System	253	3
Depreciation - Road	266-2 1/2-CX	5
Cost of Capital - Road	2 1/2-CX	5
Depreciation - Stations	266-16, 16 1/2	3
Cost of Capital - Stations	16, 16 1/2	3
Depreciation - Water and Fuel Stations	266-18, 19	3
Cost of Capital - Water and Fuel Stations	18, 19	3
Depreciation - Shops and Enginehouses	266-20	3
Cost of Capital - Shops and Enginehouses	20	3
Depreciation Signals	266-27	3
Cost of Capital - Signals	27	3
Depreciation Power Systems	266-29, 31	3
Cost of Capital - Power System	29, 31	3
Depreciation - Shop Machinery	305-59	3
Cost of Capital - Shop Machinery	59	3
Depreciation - Power Plant Machinery	305-60	3
Cost of Capital - Power Plant Machinery	60	3
Superintendence of Equipment Maintenance	301-CX	3
Maintenance of Shop and Power Plant Machinery	302	3
Superintendence	371-CX	3
Station Employees and Expenses	373-CX	3
Yardmasters and Clerks	377	3

*Source: CP Rail Costing Manual and Exhibit AMS-2, pp. 38 and 39.

Normalization Period in CN Regression Analyses*		
Description	Account	Number of Years
Roadway Maintenance Superintendence	201-CX	3
Administrative Expenses	451-CX	1
Roadway Maintenance	202-CX	5
Steam, Power & Heat	N.A.	1
Maintenance of Station & Office Buildings	227	3
Shop General Expense (OH)	235-CX	1
Maintenance of Shops & Enginehouses	235	1
Maintenance of Signals	249	1
Power Plant Systems	253	1
Equipment Maintenance Superintendence	301, 335	1
Carload Billing	373, 376	1
Freight Sales	351-CX	1
General Transportation Superintendence	371-CX	3
Dispatching & Operation of Signals	372, 404	1
Yard General Expense	377-CX	1

*Source: Canadian National Costing Manual and Exhibit AMS-1, pp. 52-54.

Results of C.N. Switching Studies
to Reflect Multiple Car Switching of Grain Traffic
1974

CNR Study Yards	Actually Charged to Grain	Charged at Average Minutes Per Handling, All Traffic
Saskatoon	5,845	6,652
Brandon	915	930
Churchill	1,064	1,064
Dauphin	3,561	3,699
Melville	3,088	3,476
Prince Albert	2,512	2,592
Regina	5,403	5,603
Thunder Bay	39,352	39,352
Winnipeg	10,662	11,863
Calgary	3,837	3,923
Edmonton	10,614	11,315
Prince Rupert	2,309	2,309
Vancouver	23,126	27,617
	112,288	120,395

Reduction: $\frac{120,395 - 112,228}{120,395} = .07$ or 7 percent

Source: Exhibit AMS-2, p. AMS-P 4.2.

CP Rail
Cut Size Analysis
Yard Switching Operations

Terminal	Grain			Non-Grain		
	Cars	Cuts	Cars/ Cut	Cars	Cuts	Cars/ Cut
Swift Current	1,169	239	4.9	429	96	4.5
Sutherland	366	29	12.6	2,681	239	11.2
Estevan	133	22	6.0	80	27	2.9
Moose Jaw	3,286	634	5.2	6,362	956	6.7
Weyburn	335	70	4.8	160	43	3.7
Lethbridge	217	65	3.3	404	109	3.7
Medicine Hat	119	17	7.0	266	39	6.8
Edmonton	163	34	4.8	203	71	2.9
Calgary	2,004	218	9.2	484	33	14.7
TOTAL	7,792	1,328	5.87	11,069	1,613	6.86

Average car/cut for all traffic - 6.41.

Source: Exhibit CP-48.

Canadian National
Allocation of Constant Costs
Winnipeg Hearing
($ Millions)

Total System Variable Costs*	$1569.0
Total System Costs**	1983.5
Total System Constant Costs ($1983.5 - $1569.0) =	414.5
Less Solely Related Costs ($35.5)	378.9
Ratio of Constant to Variable Costs ($378.9 ÷ $1569.0) =	24.1%
Grain Variable Costs (Direct Shipment)	177.7
Less on Line Costs and Inflation Adjustment	73.4
Relevant Grain Variable Costs	104.3
Grain Constant Costs (104.3 x .241) =	25.1

*Calculated by multiplying the unit cost by the work units for all accounts and totalling the results.

**As reported to the CTC in 1974.

Source: Exhibit CN-2, pp. 9 and 10 (Revised) & 146 to 158.

CP Rail
Allocation of Constant Costs
Winnipeg Hearing
($ Millions)

Total System Variable Costs (Freight and Passenger)*	$ 949.3
Total System Costs**	1175.3
Total System Constant Costs ($1175.3 - $949.3) =	226.1
Less Solely Related Costs ($24.6)	201.5
Ratio of Constant to Variable Costs ($201.5 ÷ $949.3) =	21.2%
Grain Variable Costs (Direct Shipment)	118.6
Less Solely Related Costs	23.6
Relevant Grain Variable Cost ($118.6 - $23.6) =	95.0
Grain Constant Costs ($95.0 x .212) =	20.1

*Calculated by multiplying the unit cost by the work units for all accounts and totalling the results.

**As reported to the CTC in 1974.

Source: Exhibit CP-4, pp. 18 and 19; Exhibit CP-4, Schedule 5.

Allocation of Constant Costs
Regina Hearing
C.P. Rail

Western Canada Constant Costs

1.	Western Canada Constant	$ 95.4	million
2.	Solely Related Grain Lines	25.7	
3.	Total Excluding Grain Lines	69.7	
4.	Total Constant Costs (.834 x $ 69.7)	58.1	million
5.	Total MGTM West	78.5	
6.	Less MGTM on Solely Related	1.2	
7.	Less MGTM on Lines Not Used by Study Traffic	0.9	
8.	Total MGTM Costs	76.4	
9.	Total Study Traffic MGTM	16.0	
10.	Solely Related MGTM	10.4	
11.	Study MGTM Less Solely Related	5.6	
12.	Ratio Study Traffic MGTM to Total Traffic	.073	
13.	Applicable Western Canadian Constant Costs (Line 4 x Line 10)	$ 11.4	million

System Residual Constant Costs

14.	Total System Residual Constant	$ 40.9	million
15.	Total System Variable Costs	949.3	million

Allocation of Constant Costs
Regina Hearing
C.P. Rail
(continued)

16.	Ratio of System Constant to Variable (409 ÷ 949.3)	.043	
17.	Total Variable Cost of Study Traffic Less Solely Related and Government Hopper Car Costs	$ 91.7	million
18.	Applicable System Residual Constant Costs ($ 91.7 million x .043)	$ 3.9	million

Total Constant Costs Assignable to Grain Traffic

19.	Applicable Western Constant Costs	$ 11.4	million
20.	Plus Applicable System Residual Constant Costs	3.9	million
21.	Total Constant Costs Assignable to Grain Traffic	$ 15.3	million

Source: Exhibit CP 39, pp. CP-2-R-10 to CP-2-R-14.

Allocation of Constant Costs
Regina Hearing
Canadian National

Western Canada Constant Costs

1.	West Miles of Road	12,806	
2.	Less Grain Lines	-3,720	
3.	Less Lines not used by Study Traffic	-1,891	
4.	Total used by Study Traffic excluding Grain Lines	7,284	MILES OF ROAD
5.	West MGTM	73,839	
6.	Less Grain Lines	-1,098	
7.	Less Lines not used by Study Traffic	-2,947	
8.	Total	69,794	MGTM
9.	West Constant Costs	$ 210.5	million
10.	Less Grain Lines	-31.4	
11.	Less Lines not used by Study Traffic	-37.3	
12.	Total	$ 141.8	
13.	Cost per MGTM ($141.8 million ÷ 69,794)	$ 2.0317	
14.	MGTM Study Traffic Less Solely Related	14,021	MGTM
15.	Applicable Western Canadian Constant Costs (14,021 x $2.0317)	$ 28.5	million

System Residual Constant Costs

16.	Total System Residual Constant	$ 54.3	million
17.	Total System Variable Costs	1,544.4	
18.	Ratio of System Constant to Variable ($54.3 ÷ $1,544.4)	.0352	

Allocation of Constant Costs
Regina Hearing
Canadian National
(continued)

19.	Total Variable Costs of Study Traffic Less Soley Related	$	97.6	million
20.	Applicable System Residual Constant Costs ($97.6 million x .0352)	$	3.4	

Total Constant Costs Assignable to Grain Traffic

21.	Applicable Western Constant Costs	$	28.5	million
22.	Plus Applicable System Residual Constant Costs		3.4	
23.	Total Constant Costs Assignable to Grain Traffic	$	31.9	

Source: Exhibit CN 14, pp. 67 to 79.

Annual Average of Canadian Wheat Board Selling Quotations, Basis in Store Thunder Bay, Wheat No. 1, Crop Years 1963/64 to 1973/74

Crop Year	$ per Bushel	$ per Short Ton
1963/64	$2.03[1]	$ 67.60
1964/65	1.98[1]	65.93
1965/66	2.00[1]	66.60
1966/67	2.12[1]	70.60
1967/68	1.95[1]	64.94
1968/69	1.95[1]	64.94
1969/70	1.81[1]	60.27
1970/71	1.79[1]	59.61
1971/72	1.69[2]	56.28
1972/73	2.63[2]	87.58
1973/74	5.49[3]	182.82
Recent, December, 1975	4.47[3]	148.85
March, 1976	4.47[3]	148.85

[1] Prices represented by #1 Northern.

[2] Prices represented by 1 CW 14%.

[3] Prices represented by 1 CW 13-1/2%.

Data from Annual Report 1973/74, Canadian Wheat Board, Table 24.

Source: Exhibit R-2, Table 1.

Derivation of Farm Income Submitted by Pools	1968	1969	1970	1971	1972	1973	1974	1975
Aggregate Grain Sale Proceeds (Millions)[1]	$ 1,085	739	866	1,136	1,390	1,926	3,062	3,503
Area Gross Expenses (Millions)[2]	827	803	803	868	953	1,149	1,512	1,820
Net Income (Millions)	$ 258	-64	63	268	437	777	1,550	1,683
No. of Permit Holders - Western Canada[3]	190,986	189,532	188,674	180,830	177,661	169,472	165,017	157,078
Average Net Income per Farm	$ 1,350	-337	333	1,482	2,459	4,584	9,392	10,714
Bushels Produced in Western Canada[4] (Thousands)	1,229,100	1,341,600	1,108,500	1,505,800	1,329,800	1,376,500	1,723,600	1,346,000
Net Earnings Per Bushel Produced	21¢	-5¢	6¢	18¢	33¢	56¢	$1.38	$1.25
Average Capital Value per Farm-Land and Buildings for Prairie Provinces[5]	$ 50,442	48,882	49,352	50,229	51,645	60,528	67,431 (est. 7)	69,793 (est. 7)
Average Capital Value per Farm-[5] Implements and Machinery-Prairie Provinces	$ 12,749	13,075	13,134	13,200	13,982	15,012	16,633 (est. 7)	19,390 (est. 7)
Total Capital Value	$ 63,191	61,957	62,486	63,429	65,627	75,540	84,064 (est. 7)	89,183 (est. 7)
Bank Interest Rate on Savings[6]	5%	6%	6%	4 1/2%	4%	5 1/2%	8 1/2%	7%
Minimum Return on Investment Capital Cost Allowance at Bank Interest Rate	$ 3,159	3,717	3,749	2,854	2,625	4,165	7,145	6,242
Net Income After Minimum Return	$ -1,809	-4,054	-3,416	-1,372	-116	419	2,247	4,472
Net Income per Bushel After Minimum Return	-28¢	-57¢	-58¢	-16¢	-2¢	5¢	33¢	52¢

[1] Aggregate Grain Sale Proceeds - source: Statistics Canada Farm Cash Receipts for Six Major Grains for Three Prairie Provinces.

[2] Area Gross Expenses - source: Statistics Canada Farm Net Income - Costs Attributable to Grains Determined by Formula from Western Grain Stabilization Committee.

[3] Number of Permit Holders - source: Statistics Canada - Statistical Handbook, Canada Grains Council.

[4] Bushels Produced in Western Canada - source: Canadian Wheat Board Annual Report 1974-75.

[5] Capital Values - source: Selected Agricultural Statistics, Agriculture Canada.

[6] Source: Royal Bank of Canada - Interest Rate on Savings.

[7] Figures are Estimated Using Index Figures from Statistics Canada for Various Farm Cost Inputs.

Source: Exhibit WP-3A.

Estimated Average Costs of Moving Canadian Wheat from a Mid-Prairie Point[1] to Europe[2] via St. Lawrence Ports

Year	Interior Handling Costs	Rail Freight to Terminal	Thunder Bay Fobbing	Lake Trans-portation Costs	Seaboard Fobbing & Ocean Trans-portation Charges	Total Costs
			(In Cents per Bushel)			
1933	2.887	13.8	1.484	4.662	7.351	30.184
1934	2.887	13.8	1.484	6.812	7.945	32.928
1935	2.887	13.8	1.484	5.222	9.298	32.691
1936	2.887	13.8	1.484	5.287	9.982	33.440
1937	2.887	13.8	1.484	4.953	15.111	38.235
1938	2.887	13.8	1.484	6.731	12.979	37.881
1939	2.887	13.8	1.484	5.265	14.856	38.292
1940	2.887	13.8	1.484	7.808	28.395	54.374
1941	2.872	13.8	1.484	8.333	37.524	64.013
1942	2.872	13.8	1.484	8.894	37.649	64.699
1943	2.872	13.8	1.484	9.015	37.975	65.146
1944	2.872	13.8	1.484	9.087	38.266	65.509
1945	2.872	13.8	1.484	9.511	38.493	66.160
1946	2.872	13.8	1.484	9.245	35.426	62.827
1947	2.997	13.8	1.609	11.245	32.194	61.845
1948	3.622	13.8	2.109	12.964	32.569	65.064
1949	3.654	13.8	2.334	14.137	26.530	60.455
1950	3.654	13.8	2.334	14.230	19.127	53.145
1951	4.50	13.8	2.469	17.224	44.340	82.333
1952	4.50	13.8	2.469	17.177	22.386	60.332
1953	4.50	13.8	2.469	17.139	20.572	58.480
1954	4.50	13.8	2.469	15.505	22.198	58.472
1955	4.50	13.8	2.469	14.598	30.138	65.505
1956/57	4.50	13.8	2.469	16.636	31.515	68.920
1957/58	4.50	13.8	2.594	16.624	17.500	55.018
1958/59	4.50	13.8	2.594	14.919	16.456	52.529
1959/60	4.50	13.8	2.594	14.480	17.825	53.199
1060/61	4.50	13.8	2.594	14.276	18.908	54.078
1961/62	4.50	13.8	2.594	14.331	19.971	55.196
1962/63	5.00	13.8	2.844	11.471	18.939	52.054
1963/64	4.50	13.8	2.844	11.503	23.364	56.011
1964/65	4.50	13.8	2.844	12.004	15.676	48.824
1965/66	4.50	13.8	3.246	12.136	15.207	48.889
1966/67	4.50	13.8	3.815	12.068	11.901	46.084
1967/68	5.25	13.8	4.371	10.287	14.962	48.670
1968/69	5.50	13.8	4.60	10.335	10.639	44.874
1969/70	5.75	13.8	4.90	10.574	18.677	53.701
1970/71	5.75	13.8	4.90	11.298	11.566	47.314
1971/72	5.75	13.8	4.90	12.885	8.907	46.242
1972/73	5.75	13.8	4.90	13.944	18.569	56.963
1973/74	6.25	13.8	4.90	16.04	37.14	78.13
1974/75	9.25	13.8	5.57	14.41	21.00	64.03

[1]Based on movement from a selected central Western Canadian shipping point (Scott, Sask.).

[2]1933-1968 - United Kingdom.
1968-1975 - Japan and Antwerp/Rotterdam.

Data from: Canadian Grain Exports, Canadian Grain Commission, Various Years.

EXPLANATION OF COLUMNS

INTERIOR HANDLING COSTS

Includes primary elevator elevation, inward inspection, weighing and selling charges.

THUNDER BAY FOBBING

Includes elevation, outward inspection and weighing, terminal elevator receipt cancellation and Lake Shippers' charges.

LAKE TRANSPORTATION COSTS

Includes lake freight, lake brokerage, lake insurance, rail freight and shrinkage, St. Lawrence Seaway and Welland canal tolls (St. Lawrence only), inward elevator (St. Lawrence only), and agent's commission.

SEABOARD FOBBING

Includes elevation, outward inspection and weighing, terminal elevator receipt cancellation (Clearance Association charges), superintendence, wharfage and forwarding broker charges.

OCEAN TRANSPORTATION CHARGES

Includes ocean freight and ocean insurance.

SOURCE: Exhibit R-2, Table 2.